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BACTERIOLOGY IN ITS GENERAL RELATIONS.[1]

By H. L. RUSSELL.

Bacteriology, although the youngest member of the biological sisterhood, has developed so rapidly within the past two decades, that to-day it may fairly claim for itself an independent basis. Independent, however, not in sense of isolation from other branches of scientific thought, but as occupying a field that is more or less distinct in itself. The scope of this subject has already widened to such an extent, and the literature grown to be so voluminous, that it is fairly entitled to be ranked as a separate branch of biology. This necessity is also emphasized by the difference in technique, that separates it more or less distinctly from other departments of research.

It was not until the middle of the present century that the affinities of the bacteria were even approximately determined. Zoologists first claimed this class of organisms as belonging to the animal kingdom, but gradually, as bacterial forms became better known, and more fully studied, their plant-like similarities were detemined. Botanists, for many years contributed but little toward a more perfect knowledge of this class, and it is the science of medicine that bacteriology must ever regard as its foster parent. The establishment of the causal relation between these minute forms of organic life and disease, at once invested them with increased importance and made them sub-

[1]Delivered before the Biological Club of the University of Chicago, Feb'y, 1893.

jects of paramount interest to the student of medicine. Although the main interest that bacteriology calls forth is still in its relation to medicine, broadly considered, it has proved itself so valuable an adjunct in widely different fields, that as a science, it can no longer be subordinated to any particular subject. To-day, it may fairly be said to exert a powerful influence on a number of widely separated departments of a scientific as well as of applied nature and investigations from a bacteriological standpoint have thrown much light upon many obscure problems in these different branches.

The purpose of this paper is to indicate in a general way the extent of the influence that this science is exerting on other lines of work as measured by some of the results that have been recently obtained. This can be done only in barest outline, if we would compass the entire range of its activities within the limits of a single paper. A rapid review, will however, give us a fuller comprehension of the relation that the subject as a whole bears to other departments of thought. The influence of scientific study is of a reciprocal nature, and the impetus that one branch receives from the discovery of a general principle, manifests itself to a greater or lesser degree in all related lines of study. The relation which exists between this subject in general, and medicine and hygiene must always be most intimate, for it is along these lines that the greatest advance in bacteriology has been made. It is therefore meet that in the consideration of this subject, we should first emphasize the effect that it has produced in the field of medicine, but as this is the phase that is usually presented, allusion to it here will be made only in very general terms.

Perhaps it is not too much to say, that no theory in pathology has been more fruitful of practical results than the germ theory of disease. Not only has it established the etiology of contagious maladies upon a rational and scientific basis, but it has formulated well defined principles of treatment that are now successfully employed, particularly in the departments of surgery and hygiene. What was once blindly accepted as a "visitation of Providence," from which there was no escape, is now known to be due to the action of these minute forms of

organic life. To-day we consider them in the light of science rather than the gloom of superstition, and the terror of devastating pestilence is largely diminished when its cause is unmasked.

Perhaps on the whole the greatest benefit that bacteriology has conferred upon the "healing art" lies in the fulfilment of the old adage "that an ounce of prevention is worth a pound of cure." It has shown its value mainly in *preventing* rather than in *curing* disease, so that prophylaxis has gained far more than therapeutics. A more intimate knowledge of the conditions aiding or retarding the development of bacteria has resulted in improved methods of sanitation, by which the physician is able to circumscribe and control an outbreak of contagious disease.

Our knowledge of all the conditions of bacterial development is as yet comparatively limited, but the application of the principles that have already been established, has aided materially in checking the progress of these types of disease. Among these, the cholera epidemic of last year is a notable example. Starting from its native home on the Ganges, where it is endemic, it travelled step by step, following the lines of commerce. Entering Europe by way of Russia, where amid its squalid and famished millions, existed the most favorable conditions for its propagation, it was further spread by exiled Jews, who carried the contagion to many of the commercial marts of western Europe. The history of past epidemics demonstrates that its march westward has been almost always unobstructed, and had we been living in the light of two decades ago, it would probably have ravaged the denser portions of the west, as it has done in the past, and as it does in the east to-day. We may not be able to stamp out the scourge at once, but it cannot be denied that the restrictive methods of the German Government last season, checked the spread of the epidemic in that country, and our efficient quarantine regulations prevented its gaining a foothold in our metropolis. We may not know all there is to be known concerning the character of the contagion, but what we have already learned, points to a more

successful method of action in repressing it than any we have heretofore possessed.

Prophylaxis, or preventive treatment, may be carried on in two ways. We may prevent disease, either by destroying the cause of the infection, or by rendering our bodies refractory to the attack of the disease germ. The first is accomplished by disinfection, the latter by preventive inoculation. What Jenner did with small-pox is an entirely empirical manner, modern bacteriology has effected in the light of established principle. The brilliant researches of Pasteur and his pupils along these lines, not only in the case of human infection as in hydrophobia, the mortality of which at the Pasteur Institute at Paris has now fallen to less than one-half of one per cent., but also certain animal diseases like splenic fever in sheep and cattle, erysipelas in swine and cholera in fowls, are practical testimonials of the advance that modern bacteriology has to offer in the direction of prophylactic treatment. The Berlin school, while it has not as yet succeeded in applying its methods in so widespread and practical a way, has placed the question of acquired immunity upon a firmer scientific basis. The discoveries of Fränkel, Brieger, Kitasato, Behring, and Ehrlich are all of supreme importance from an experimental standpoint. These observers have been able to immunize various animals by artificial means against such diseases as tetanus, diphtheria, pneumonia and erysipelas of swine. Not only have they endowed the animal body with such properties that it can successfully antagonize either the germ or its toxic product, but in some cases, have actually restored the animal to its normal healthy condition after the disease had been established.

How far these results can be utilized in combating disease in the human system is not yet definitely known. In the consideration of the probable value of these results to therapeutics, we need to be conservative in our conclusions, for the conditions are widely different between an experimental disease in animals and its natural course in man. From the present outlook, it seems that any permanent advance along this line will be based upon successful efforts in securing artificial

immunity. The conditions must first be worked out experimentally upon the lower animals, and it will require patient and extended research before they can be applied to human ills. The most pronounced results so far in this connection, are accomplished by the *blood serum therapeutic methods*, as demonstrated by Behring and Emmerich. This theory rests upon the conception that in an animal artificially immuned, a certain change has taken place in the blood serum by which it has become endowed with antibacterial, as well as with antitoxic properties; also that the serum of an animal thus protected possesses in itself a positive therapeutic value. Kitasato, two years ago, succeeded in rendering mice so refractory toward the poison of the tetanus bacillus, that they were able to withstand an injection of three hundred times the ordinary fatal dose. The serum of these immuned animals when injected into susceptible controls, that had been infected with virulent tetanus cultures was able to arrest the progress of the disease even after the characteristic symptoms of tetanus had been manifested throughout the body. Not only has this course been applied to experimental tetanus in mice, but rabbits, dogs, horses and sheep, all of which are susceptible to the disease, have been rendered refractory by these artifical methods.

This plan of treatment has recently been used in tetanus in man. The curative substance was secured from the serum of artificially immuned rabbits and dogs, and there are already on record over a dozen cases of human tetanus that have been successfully treated by this method of inoculation. Some of the cases were so far advanced that paralysis had already set in, yet the injected material was able to neutralize the toxicity of the poison, and inhibit its further production. The application of this method to other diseases analogous in character promises favorable results, and the problem to-day in this connection, lies not so much in further proof of the theory, as it does in the ability to artificially immunize animals of adequate size to procure the serum in sufficient quantities to be utilized in actual practice. Behring has succeeded with diphtheria in conferring immunity upon rabbits and guinea pigs and has found that their serum is likewise able to check the experi-

mental disease in infected controls. Subsequently he accomplished the same result in animals of the size of sheep, rendering them resistent to the infection, so that the serum in adequate quantities can be secured for use in the treatment of the human disease.

Medical science awaits with intense interest the next step, and it is possible that in the near future "the red demon of the nursery" will be brought under control.

Turning from the beneficent results which have been secured to medicine, to other lines of activity, the results of bacteriological research are equally efficient. Chief among these are some results obtained in reference to agriculture. In its relation to medicine, bacteriology deals mainly with those forms that have adapted themselves to a wholly, or semi-parasitic mode of existence. These however represent but a minor fraction of the whole number of species that have been isolated. In agriculture, saprophytic, as well as parasitic species enter into consideration, and here parasitism is not confined to the animal body as a host, but is to be observed in plant tissue as well. To the agriculturist then, bacteria come in a dual guise. They are both a friend and a foe. Some species are to him a direct benefactor, some render him aid in a more indirect manner, while others are a positive detriment to the success of his calling. How to increase the activity of the friendly forms, and diminish the ravages of the noxious ones, is the constant study of the agricultural bacteriologist.

The field, which for convenience we here classify as agricultural bacteriology, is made up of so many widely separated subjects, that the detailed methods in one class, cannot be successfully utilized in the examination of another. For example, the attempt to isolate the organism of nitrification which baffled investigators for so long a time, was fruitless mainly because they relied almost entirely upon the gelatine method of Koch. Each special subject must be studied by itself and the technique developed for the method of work in establishing the etiology of a bacterial plant, disease differs widely from that which must be used in studying the processes of nitrification or the fixation of the free nitrogen of the

atmosphere. In reviewing the progress of agricultural bacteriology, we can only allude to the lines of work which have been opened up in this fertile field of research. It may be confidently asserted that as yet, we stand on the threshold of discovery in this department, and the work can scarcely be said to be more than inaugurated. What the possibilities of the future are, no man can safely predict.

Study in veterinary pathology has gone hand in hand with that of human disease, and the etiology of numerous contagious diseases in domestic animals have been thoroughly investigated. Actinomycosis in cattle, glanders in horses, and splenic fever in sheep besides numerous other septicemic diseases, like hog-cholera, swine plague, chicken cholera, *rouget* or swine erysipelas are classic examples in our text-books. A fuller knowledge of the history and etiology of this class of diseases, has not only better enabled the farmer to check their spread, both by remedial and prophylactic treatment, but it has awakened an economic interest that is steadily progressing along practical lines.

Besides these parasites, confined to animal organisms, the husbandman has to contend with a series of forms, which only find their normal hosts in vegetable tissue. The farmer and horticulturist need to be always on the alert to protect their harvests from the ravages of these enemies. Insects and fungi are an ever present menace to success, but not a small number of plant maladies are to be traced directly to a bacterial source. Such destructive diseases as the apple and pear blight, the tuberculosis of the olive, the "yellows" of the hyacinth, as well the blight of oats, sorghum, Indian corn, and other cereals are often due to an invasion of germs of a bacterial nature. The conditions by which these diseases are propagated and spread are such, that some of them can be eradicated, now that we know how the infection is transmitted. To illustrate, the pear or fire blight, which has been observed in this country for a hundred years, and which in some sections has become so destructive as to practically ruin the industry, can now be managed with comparative ease. Through the researches of Waite, it has been ascertained that

the infection is transmitted by insects in their visits to the flower for nectar. The germs thus carried from an infected to a healthy tree are deposited on the nectary as the insect garners the honeyed store. A lodgment effected, the germ finds a rich nutrient medium and it multiplies profusely, penetrating finally the exposed cells of the nectary, which are destitute of a cuticle. With an entrance once established, the contagion spreads from blossom to twig, from twig to branch, until at last the whole tree structure becomes involved, and falls a prey to the disease. Since we have learned that the blackened leaves and branches contain the virus, it becomes only a matter of watchfulness and care on the part of the husbandman to check and ultimately stamp out the malady by the excision and burning of the diseased tissue.

Another problem of vast importance not only to agriculturists, but to sanitarians, is the subject of nitrification, or the conversion of nitrogen bearing substances into nitrates and nitrites. It has been an established fact, known for years, that under certain conditions, there was an increase in the nitrous and nitric salts in the soil, but just how this was brought about, was for a long time an unsolved problem. Chemists had explained the phenomenon on a purely chemical basis, and it was believed that the nitrogen of the air was oxidized, either by the action of ozone or oxygen. Pasteur as a result of his studies on fermentation was the first to suggest that the production of nitric acid in the soil might be due to organized ferments. This idea was taken up by Schloesing and Müntz fifteen years ago, and the working out of the present accepted biological theory of nitrification is largely due to the untiring labors of these eminent French investigators, as they laid the basis for the more brilliant and successful results of Winogradsky and Warington.

Interesting as is the story, time will not permit entering upon the detailed steps by which the germ theory was finally proven. For a number of years after it had been shown that organized ferments played the chief rôle, no advance was made in the isolation of the organism as the different investigators failed to produce any nitrification with the germs they

had separated from the soil. Warington states, that over a hundred different species of bacteria had each been carefully tested as to their ability to nitrify ammoniacal solutions and that with every one a negative result was reached. It is less than three years ago that the efforts of bacteriologists to obtain the specific cause of the process were crowned with success. Frankland isolated the germ by dilution, and at the same time Winogradsky succeeded in separating it by another process. The unique feature of this germ was that they could not make it grow upon gelatine. This peculiar individuality explained the failure of previous investigators who had confined their methods to gelatine media. Experiments demonstrated that this germ was only able to oxidize ammonia into *nitrous* acid. Important as was this discovery, it was only one step in the process. The conversion of nitrous acid and its salts into the more stable nitrates, eluded their best efforts.

Winogradsky at last succeeded in isolating the organism from mixed cultures by the use of gelatinous silica mixed with inorganic salts.

In this way the various steps of the process were clearly demonstrated and the biological theory of nitrification was established upon a firm and scientific basis. This theory claims that the nitrification of ammonia in the soil takes place in two successive stages, the change in each case being produced by distinct and separate organisms. In the first stage ammonia is oxidized into nitrous acid and then this is acted upon by another (a second) organism and is converted into a nitrate. Ordinarily, as observed in nature, the two processes occur simultaneously so that the ammonia passes in continuous combination from its simpler form into its ultimate stage as nitric acid, or some of its salts. The economic value of this discovery cannot be estimated. It is not only a complete and satisfactory scientific solution of a complex process, but is of invaluable aid to the agriculturist in demonstrating to him the source of the most essential element in soil restoration and in teaching him how he can best conserve and utilize this expensive product.

It has also an important bearing upon certain phases of

hygiene for the success of the intermittent filtration of water through the soil seems to be based upon the nitrifying action which takes place within the filter. Filtration has been in use a long time as a means of water purification and the theory that bases its efficiency in the mechanical or chemical separation from its impurities has long been the accepted one.

Many of the observed facts did not seem however to accord with this explanation, and when it was found that certain protoplasmic poisons like chloroform injuriously affected the efficiency of filters, the relation between it and living organisms was suspected. This led to a careful study of the question from a bacteriological standpoint, and the discovery was soon made that there was a direct relation between the process of nitrification as it went on in the filter and its effectual operation.

The solution of another interesting subject, that of the fixation of the free nitrogen of the air by certain plants, also bids fair to be solved by bacteriological methods. Agriculturists long ago recognized the fact that certain species of plants belonging to Leguminosæ, such as clover, alfalfa, etc., possessed special properties in enriching the soil; that not only could these crops dispense with the application of fertilizers, but that they possessed the elements by which impoverished soils might be restored to their original fertility quicker and cheaper than by any other method. This knowledge, the fruitage of observation and experience awakened an interest in the causal relations between the one and the other, productive of many interesting and ingenious hypotheses. Liebig concluded that as clover could be grown upon the same ground for years without the addition of fertilizers, that it must absorb nitrogen direct from the air through its aerial organs, and then transfer this store to the roots, and so enrich the soil. Carefully conducted experiments have failed however to reveal any direct absorption by the leaves and stems of plants. This peculiar property, limited so far as we at present know, to the Leguminosæ was finally correlated with the presence of small excrescences or tuberculous swellings on the roots of these plants. These are found in great profusion on the young rootlets of

this class of plants, and seem to be universally absent in all other genera.[2]

For a long time they were regarded as pathological structures, and it was only when it was found that legumes grown in *sterilized soil* were poorly nourished and entirely devoid of tubercles, that the causal relation of these structures with the peculiar property of the plant was recognized. These observations were followed by more systematic experiments by Hellriegel and Wilfarth, who discovered that the production of the tubercle depended upon the germ contents of the soil. Beyerinck, Prasmowski and others succeeded in isolating the germ which possessed the ability to penetrate the young root hairs and the cortical parenchyma of succulent roots. These bacteria set up an irritation in the plant tissue that causes the formation of a meristem, and thus the tubercles are produced as lateral outgrowths from the root.

The tubercle is filled with peculiar shaped bacteria, which possess the ability in some way not yet perfectly understood, of fixing the nitrogen of the air in such a condition that it can be utilized by the plant. Our knowledge concerning the details of the process is far from complete, but this rational explanation of the phenomena has opened the way for further research. The problem that at present awaits solution is to find whether there is any difference between the organisms infecting one variety and those that are symbiotic in another.

The artificial selection and cultivation of these forms that have the greatest ability as "nitrogen collectors" is a question of prime importance. Like that of nitrification it involves great economic interests, inasmuch as it is the key to the solution of the important question of the restoration of impoverished soils.

It would be treating our subject in a very imperfect manner were we to close our résumé of the influence that bacteriology

[2] Recent experiments (Landw. Vers. Stat. XLI, 138) seem to indicate that the tubercles on the roots of *Elæagnus angustifolia*, a member of the Elæagnaceæ, a close relative to the Leguminosæ are developed by bacteria. Infection by means of soil washings of sterilized soil planted with these seedlings gave more luxuriant growth than controls in sterilized soil. The organism has been isolated in pure culture and is found to differ from *Bacillus radicicola*, the form so common in the legumes.

has exerted upon argricultural pursuits without stating the position of it with reference to dairying.

Milk, like every other organic substance, is subject to certain changes, and these conditions are now known to be directly traceable to the influence of micro-organisms. These so-called "diseases" of milk are mainly fermentative in their character and modern bacteriology has shown the dairyman that they can be entirely prevented if he handles his product in a rational way. Milk, as it comes from the cow, is entirely devoid of germ life, but its high degree of temperature when freshly drawn and the exceedingly nutritious food medium that is offered, afford the optimum of conditions for the development of any bacteria that find their way into the fluid. The ubiquity of distribution of fermentative organisms render it impossible to entirely avoid their action, but the losses of the milk-dealer can be greatly diminished if cleanliness is scrupulously observed.

While the milkman wishes to avoid bacteria as far as possible, the buttermaker should welcome them as his friend. Many forms are, of course, undesirable, but from the recent investigations in this field there is no question but that the bacterial content of butter largely influences its keeping qualities as well as the peculiar flavor for which such fancy prices are paid. The process of "ripening" or "souring" cream that is practiced by every butter maker is a natural bacterial fermentation. Better and more butter is obtained from ripened than from "sweet" cream. If this is so, the question naturally arises, Why can we not isolate the forms that are capable of prorucing these changes and add them directly to the cream rather than to trust to their spontaneous development? The researches of Hansen in the realm of pure yeast ferments have revolutionized the brewing industry within the last five years, and the introduction of pure cultures of yeast for fermentative purposes has made a better, and what is still more important, a more uniform product. Now the same field seems to be opening in the process of butter-making. Danish and German creameries are now being supplied with pure bacterial cultures that are

early added to the cream in order to produce as a result of the fermentative changes the desired flavor.

In this way uniformity of product is assured, and as many undesirable forms are choked out by the introduction and control of pure cultures, the keeping qualities of the butter are much improved.

The utility of bacteria in connection with milk and its products may still be further extended, for the necessity of their presence in cheese making is even more imperative than in butter making. Here they are an indispensable requisite to the production of a palatable product. New cheese is flat and insipid, and it requires a certain period of time in which it undergoes a change that is called the ripening or maturing stage before it is fit for use. Duclaux and others have shown that the production of the delicate flavors are due to the transformation of the casein into soluble albuminoids by means of the ferments that are produced as a result of bacterial growth. This ripening process is then due to the action of specific germs. The various kinds of cheeses that possess such a variety of flavors are, no doubt, due to the action of different forms of bacteria, but the threshold of this work is scarcely more than crossed, and, as one of the leading experts in this country has said, further advance in perfecting the processes of cheese manufacture is impossible, unless they include the aid of bacteriology.

(*To be continued.*)

A CASE OF LATEROVERSION OF THE OPHIDIAN HEART.

By Pierre A. Fish.

The specimen had already been partially dissected by one of the laboratory students in the Anatomical Department (Cornell) before attention was called to the peculiar cardiac arrangement.

The body had been divested of its skin until within six centimeters of the vent and seven centimeters of the tip of the mandible; the cranium had been removed, leaving the mandible still attached to the body; the heart had been exposed and the ventral portion of the pericardial sac, if any had existed, was gone. A normal specimen was put into the hands of the student for further dissection and the anomalous one has awaited careful examination since 1891.

Enough characters remained to enable one to identify it with a reasonable amount of certainty as *Ophibolus doliatus* var. *triangulus* or as commonly known, the spotted adder or milk snake.

Its total length was 85 centimeters (2 feet 10 inches); from the tip of the mandible to the apex of the heart the distance was 11 centimeters, the heart itself from the apex of the ventricle to the base of the right auricle being 1·8 centimeters.

The interior of the pericardium (already exposed) presented a somewhat cone-shaped cavity through the length of which, and a little to the right of the mid-line, the pulmonary and post caval veins passed. These did not lie freely in the sac but were held in place by a narrow, but distinct fold projecting from the dorsal wall of the pericardium.

A considerable depression for the reception of the ventricle was formed just cephalad of the auricles by a sinistral deflection of the trachea and œsophagus; the trachea also showed signs of compression on the side adjacent to the heart. No trace of a true pericardium was apparent here, but there seemed to be a somewhat excessive development of connective tissue.

Aside from the very peculiar position of the ventricle, one of the most striking features was the unusual engorgement of the vessels of the left side with blood, in the immediate proximity of the heart. The left auricle also presented this feature while the right was comparatively empty.

A superficial examination of the conditions seemed to show that there had been a complete ante-version of the whole heart, the ventral surface becoming dorsal and the dorsal ventral. On carefully removing the dense connective tissue covering the surface of the ventricle, this conclusion was shown to be erroneous from the fact that the aortic arches were found to arise from this apparent, and at the same time real ventral aspect. This as well as some theoretical reasons would demonstrate quite effectively that true ante-version could not have occurred.

What appears to be the most logical inference, and dissection seems to confirm it, is that rotation must have taken place, the fixed point being at about the place of divergence of the two aortic arches; and since the apex of the ventricle points in a diametrically opposite direction to that found in the normal condition, it must therefore have passed from right to left and through an arc of 180°—provided the heart was ever normal. The apparent left side of the ventricle would then be the true morphological right side and *vice versa*.

The auricles would naturally tend to follow the ventricle in this rotation, but there is no very marked displacement of their relations to each other. This does not hold true with regard to the ventricle in its new location, for the apparent right, but really the morphologically left side is in a line with the right auricle and the morphological right side is in a line with the left auricle.

An effectual restraint would be offered against this migratory tendency of the auricles, in the case of the right auricle by the pulmonary vein which would prevent its passing the mid-line. And similarly for the left auricle by the left aortic arch, which would prevent any movement of the auricle in a cephalic direction. The usual disproportion of size between the two auricles is not evident, though this may be accounted for by

the collapsed condition of the right as compared with the left side. The ventricle if it has rotated must have passed along the ventral aspect of the left auricle.

After a careful and completer dissection of the heart and the vessels adjacent to it so that the parts could be more easily manipulated, it was found that the ventricle could be returned to an approximately normal position which assisted quite materially in elucidating the relationship of the vessels to the heart and to each other.

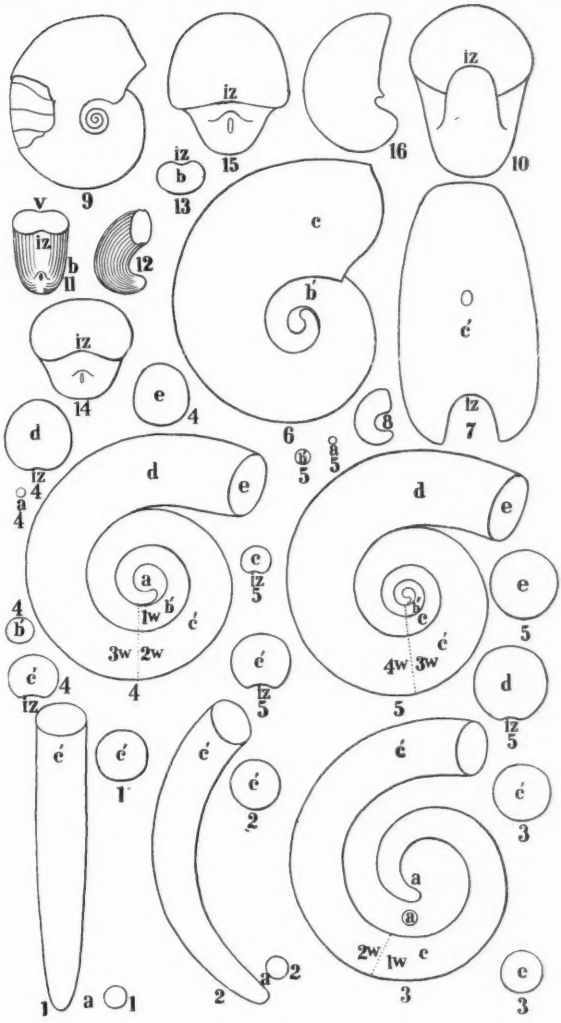
The two aortas at their diverging point are twisted half around each other, the right in this case being smaller than the left and sending off only one branch—the cervical artery; the right aorta then passes dorsad of the trachea and œsophagus in an oblique caudal direction until it meets the left to form the common aorta.

The left aorta presents a peculiar enlargement shortly after emerging from its "twist," due perhaps to over-distention with coagulated blood, and at the point of the greatest convexity of its curve it sends off the carotid artery and gradually diminishes in calibre until it meets its fellow. It would appear from this that the left aorta, instead of being a mere connecting branch as is usually the case, has assumed the chief function of the right, supplying the head with blood through the carotid. The two aortas retain their crossed origins at the ventricle as in normal specimens. It is not improbable that the right aorta suffers more by the twisting than does the left, causing a greater retardation of the flow of blood and thus offering a possible explanation for its diminished size and partial loss of function.

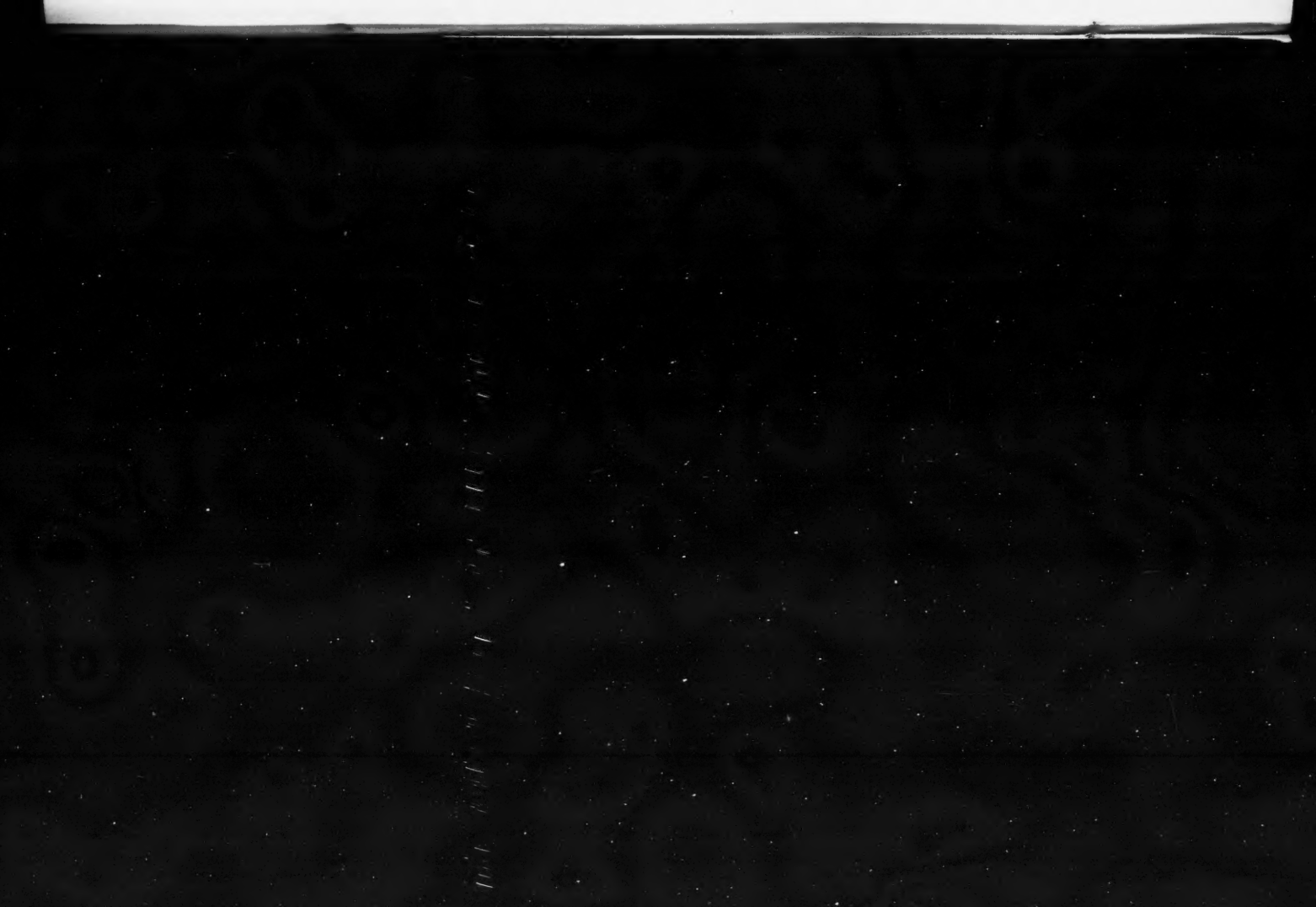
The right jugular vein was somewhat enlarged near the heart but empty and was partially compressed by the ventricle. At about the level of the auriculo-ventricular furrow it receives the (pre?) azygous vein and the common venous trunk, which is of smaller calibre than the jugular, then follows the dorsal contour of the right auricle, arching over to enter the sinus venosus at about the point of entrance of the postcava.

The position of the sinus which normally is perhaps more

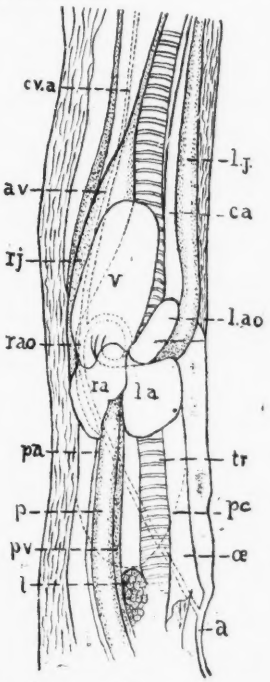
PLATE XVIII.



Hyatt on Cephalopoda.



dorsal than lateral has, on account of the rotation, assumed a more nearly mesial and ventral location, thus bringing the postcava in line with the pulmonary vein to which it seemed to be quite closely adherent. The left jugular vein likewise presents a central enlargement and forms a sling-like support for the arch of the left aorta.



In the intricate and unusual arrangement of the parts here, the vein was inadvertently cut so that its course to the right auricle could not be satisfactorily determined.

The pulmonary vein passes from the lung through the pericardial cavity accompanied by the post-cava and passes between the two auricles more ventral than dorsal and enters the left auricle.

The significance of the central enlargements of the left aorta and the carotid artery and of the left and right jugular

veins is not apparent, unless they may in some way be correlated with the anomalous position of the cardiac parts. These vessels nearer the heart are of smaller calibre, and on account of their twisted condition must retard the flow of blood considerably, the enlargements, then, may function as reservoirs for a reserve blood supply.

Such factors as gravity, pressure, mode and direction of progression would militate against the view of a post-natal development of this anomaly and would render more plausible the idea that it was due to some congenital or fortuitous embryonic condition.

The accompanying figure was traced from a photograph enlarged three diameters, the veins are shaded; the dotted lines indicate vessels that were too deep or insufficiently dissected to show at the time of photographing, and have been filled in freehand.

Specimens of *Eutænia sirtalis*, *Tropidonotus sipedon*, *Crotalus horridus*, and *Python molurus* were used for controls. Among them some interesting facts were observed which may serve as a basis for a future paper.

Reference letters. *a*, common aorta; *av*, azygus vein; *ca*, carotid artery; *cva*, cervical artery; *l*, lung; *la*, left auricle; *lao*, left aorta; *lj*, left jugular; *œ*, œsophagus; *p*, postcava; *pa*, pulmonary artery; *pc*, pericardium; *ra*, right auricle; *rao*, right aorta; *tr*, trachea; *v*, ventricle. Magnified 2 diameters.

PHYLOGENY OF AN ACQUIRED CHARACTERISTIC.

By Alpheus Hyatt.

An acquired character is a modification which makes its appearance in the adult or later stages of development and is obviously dependent for its origin upon other than hereditary causes. I have elsewhere defined that branch of science which deals with such problems as Ctetology and such characters as ctetic or acquired. The characteristic dealt with in the paper of which this is an abstract, is of essential importance among Nautiloids and Ammonoids or all of the Cephalopoda having chambered shells and living within their shells. It consists mainly of an impression made on the inner side or dorsum of each outer whorl during the coiling up, as the whorl grows and is moulded over the venter or outer side of the next inner whorl.

This matter will be better understood, if a short description is given of the following figures. Figs. 1–2 show an almost

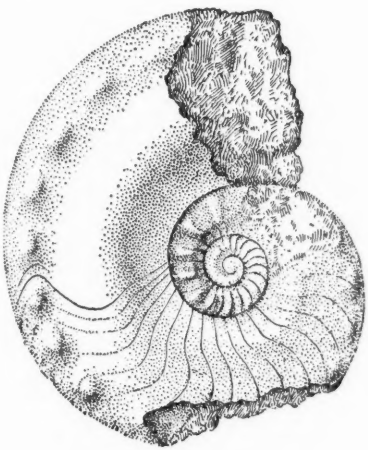


Fig. 1.

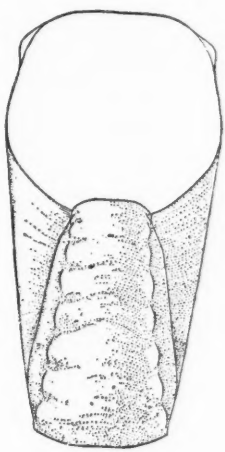


Fig. 2.

complete fossil cast of a full grown *Metatoceras cavatiformis* Hyatt, and some of the lines or sutures made in the external surface of the cast by the intersections of the partitions or septa that cut up the coiled tube of the living shell into air chambers. Figs. 3–4 show a broken specimen of the same

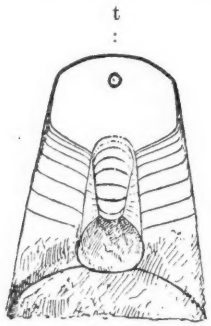


FIG. 3.

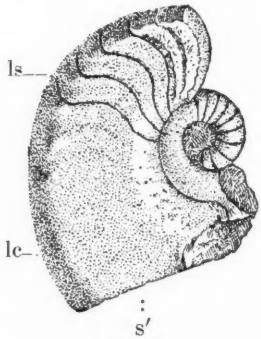


FIG. 4.

species, but with the outer and older whorls in large part removed. The innermost septum near the center of the coil was built across the interior after the animal had constructed the hollow apex or point. It then moved along adding to the external wall of the tube, which has been destroyed and removed from this cast, and built the second septum, and so on until it reached the tenth septum. By some freak of fossilization a number of the septa beyond this have been destroyed, so that if we were to remove the fragment of the external whorl and take out the center which has just been described, this would have the exact aspect of a cast of a young shell with ten air chambers.[1] The eleventh air space or chamber being open and without divisions would then appear to be the living chamber which the animal occupied when it built the tenth septum. Normally the shell really continued to progress from the tenth septum by additions to the outer

[1] The shaded area in the center, shaped like a large inverted comma, was an open space in the living shell. This is almost invariably filled by the rocky matrix in which the shells occur and is often, as in this specimen, allowed to remain. See also figs. 4, 5, 6, on Pl. XVIII, which show the comma shaped umbilical perforations or openings left at the center through the crytoceran form of the young.

wall and put in new septa behind it, together with the connecting tube until it reached s′, and finally the last septum, l. s. This one, l. s., was really the last one built and it formed the floor of a true living chamber, l. c., formerly occupied by the animal at the time of its death and burial in the sediment of the Carboniferous period. Figs 1–2 show a similar fossil but with a longer, although still incomplete living chamber. If the external wall of shell had been preserved none of these structures could be seen. Figs. 5–7 show a fossil *Temnochilus crassus*, a shell of the same family with this external wall pre-

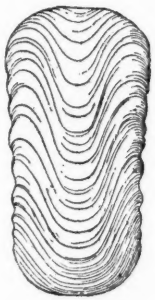


FIG. 5.

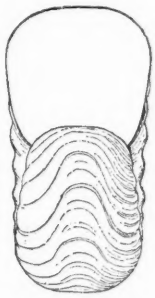


FIG. 6.

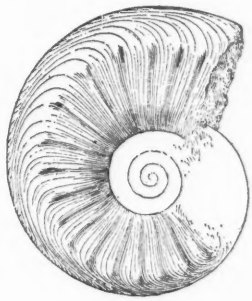


FIG. 7.

served and all these internal structures covered up. The impressed zone is the re-entrant curve shown in all these figures and especially marked in the lower outline of an outer whorl of another Carboniferous species, *Metacoceras dubium* Hyatt, fig. 8, im. z.

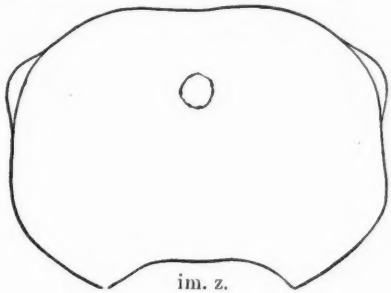


FIG. 8.

It is not necessary to go into a discussion of the details of internal structures and their relations to the impressed zone in this abstract, but it is essential to give a general description of the morphogeny of the order of Nautiloids.

This group of chambered cephalopods contains the following classes of forms: first, straight, conical shells, type Orthoceras, pl. XVIII, fig. 1; second, curved cones, Cyrtoceras, pl. XVIII, fig. 2; third, loosely coiled, open whorled cones, Do., fig. 3; fourth, coiled cones with the whorls more or less enveloping, Do., fig. 5. The fourth and fifth forms are usually included in the old genus, Nautilus. Practically, it is better to designate the first class as orthoceran, the second as cyrtoceran, the third as gyroceran, and the fourth and fifth as nautilian. In tracing genetic series through time they are found to diverge in their evolution, starting with the orthoceran and passing through parallel lines of forms, many of the genetic series having in succession cyrtoceran, gyroceran and even nautilian forms of the fourth and fifth classes. Others are not so perfectly parallel, stopping short with the cyrtoceran class of forms or the gyroceran. Many also begin with cyrtoceran shells, while others diverge from the gyroceran, and still other series have only nautilian shells of different grades of close coiling and involution.

The application of the law of repetition in heredity to the chambered shell-covered Cephalopods, shows that the straight orthoceran shells, pl. XVIII, fig. 1, were repeated in the young of the curved cyrtoceran forms, pl. XVIII, fig. 2, and these forms in their turn in the young of the gyroceran forms, pl. Do., fig. 3; and this may be seen by comparing the young or apical part of each shell represented in outline with the full grown shells of the preceding figures. The apex of fig. 2, with the whole of fig. 1; the apex of fig. 3, with the whole of fig. 2. It will be understood, of course, that the figures in outline represent full grown shells, except when otherwise explained and that they were built like the shells of figs. 1–2, by an animal living in their interiors and adding band after band of shelly matter to the exterior, but in these outlines the shell is sup-

posed to be perfect and the internal structures concealed.[2] The young of pl. XVIII, fig. 4, which represents the fourth class of forms repeats the cyrtoceran form, then curves more closely and just before it comes in contact there is a short time when it overlaps the apex without touching it. At this time it is plainly gyroceran like the whole of fig. 3. After it touches the first whorl just beyond the apex it remains in contact and the inner side or dorsum of the second or overlapping whorl begins to show a flattening as a result of this collision of the whorls. The sections of the orthoceran, cyrtoceran and gyroceran whorls show no such flattening in any of the specimens examined, although hundreds of different kinds have been studied. The sections are designated on the plate by the same letters as the supposed lines of the sections made through the tube, and although diagrammatic figures, they give a sufficiently clear general explanation of the facts observed. More specific figures could have been given in abundance and will be given in the paper now in course of preparation.

Pl. XVIII, fig. 5, shows the same phenomena as figure 4. The young is at first cyrtoceran like the adult whorl of figure 2, and open, then becomes gyroceran in curvature and finally overlaps the apex when it has arrived at the end of the first volution, but does not at first touch it. Then coming into contact it acquires a flattened area or faint impressed zone on the dorsum or inner side of the second volution as is shown in the section fig. 5c. This is similar to the section of figure 4 shown in fig. 4c′, which represents a cut through an adult whorl of the fourth class of forms. It differs only in being smaller on account of the younger stage of growth at which it occurs.

The entire series of forms from orthoceran to nautilian is more or less represented, even in the earliest period at which the Nautiloids appear, namely, in the rocks of the Quebec Group. There is, however, this qualification: the fifth class of forms, or the involute nautilian, are comparatively rare and become more abundant in successive periods. The young

[2] Except in fig. 9 in which a portion of the shell is broken away showing the cast of the interior and the sutures.

of Nautilian shells of the earlier periods are also not so closely coiled, or, in other words, remain open and similar to cyrtoceras for a longer time during their growth. This is shown by the large size of the central hole, or umbilical perforation, left in the center of full grown shells. This perforation is much larger, as a rule, in Paleozoic than in the Mesozoic forms.

In each period the genetic series or groups of nautilian forms have peculiarities of structure in the sutures, ornaments apertures, etc., by which they can be separated from each other and these peculiarities are the same as those possessed by gyroceran, cyrtoceran and often orthoceran shells which occurred often earlier in time so that one can trace each group of nautilian shells back to its ancestors through the parallel stages of evolution above described. The groups, in other words, are parallel in their morphogenesis, like two individuals of the same parents in their development from youth to old age.

In all of these cases the impressed zone originates as described above after the whorls come in contact, never before this time in the growth of any individuals. Barrandioceras is one of the most involute shells known in the Silurian, and pl. XVIII, fig. 6, gives a true sketch of this species; fig. 7, shows a section of a full grown shell with a decided impressed zone; and fig. 8, is the young. This last is a purely cyrtoceran form with a compressed elliptical section like that of fig. 7, but no impressed zone, the inner side being rounded like the diagram of Cyrtoceras, fig. 2. The impressed zone is not present in the young of Ophidioceras, the closest coiled of all these forms, nor in the young of any species of the Silurian before the whorls touch, so far as known, and all of the species likely to present this peculiarity have been investigated.

The impressed zone is also invariably lost in the oldest stage of the whorl of every individual when the whorls cease to continue to grow in contact. This condition is represented in the last part of the outermost whorl of figs. 4 and 5 in sections, figs. 4e, 5e, and in the outlines of their apertures which are elliptical. The sections represent cuts through the whorls

when, as is the case in extreme age, these cease to increase in size. As soon as this senile contraction begins to occur the sides shrink, becoming narrower, the amount of involution becomes less, and the impressed zone, shrinks in breadth as shown in the sections. When the whorl finally parts company in consequence of continued contraction the already shrunken impressed zone, figs. 4d, 5d, rapidly disappears and the apertures of such shells are frequently as round and free from indentations on the inner as on the outer side, as is shown at the free end of the figures 4 and 5.

In normally uncoiled forms, usually named Lituites, when the adult or young is coiled, and the succeeding stages, whether representing adults or old shells, are uncoiled, the phenomena are similar. The impressed zone is lost after the growth ceases to bring the whorls of the shell into contact.

The young and the adults of many of these forms have now been observed in the earliest periods and it is, therefore, obvious that during these early times the impressed zone must have been a modification of the whorl which took place in consequence of the mechanical effects produced by close coiling. This characteristic is slight when the coiling is slight and is developed in precise proportion to the increase of coiling or involution of the whorls and, on the other hand, when through degeneration due to age, or to other causes, the whorls cease growing in contact, the impressed zone gradually disappears.

Thus it always appears preceded and accompanied by an observable tendency in the mode of growth toward closer coiling and that this tendency is quite capable of producing the impressed zone can hardly be denied with any show of reason, since the charateristic disappears in proportion as the pressure is relieved through the degeneration of the powers of growth force to continue the normal rate of progressive increase of bulk in old or young or prematurely degenerate shells and in uncoiled whorls of all kinds and all ages.

The shells of Devonian series of Nautiloids have also been extensively examined, especially in the more involute nautilian forms of the genus Nephriticeras, and so far not one has been found with the slightest indication of the presence of an

impressed zone in the cyrtoceran or gyroceran stages of development. In several examples also, the disappearance of this characteristic has been observed in the last stages of old whorls. There is, therefore, every reason for regarding the impressed zone as a ctetic characteristic acquired in the later stages of growth and not hereditary so far as is known in any shells of the earlier paleozoic periods.

The same statement may also be made with regard to the majority of Carboniferous shells. There is, however, a notable exception in *Coloceras globatum* (sp. De Kon.) Hyatt, and very likely some other species of closely coiled nautilian shells. In *C. globatum* of Visé, Belgium, I found in seven specimens that the impressed zone appeared while the whorl was still in the cyrtoceran stage. Pl. XVIII, figs. 9–10, give outlines of the adult of this species, and figs. 11–12, of the young and the zone, showing that the impression appeared long before the whorls touched each other and began to assume nautilian characters. Section, fig. 13b, shows the impressed zone occurring in the cyrtoceran stage while the venter or outer side of the whorl was rounded. Such facts admit of but one explanation, namely, that in this species the impressed zone had become hereditary and was in consequence repeated at an early age, previous to the occurrence of close coiling which produced it in the ancestral forms of the same group.

There are certain correlative characters which lead me to think that this is only a partial statement and perhaps a more complete and better one would be as follows: that the impressed zone, together with a peculiar broadening out of the dorsum and helmet-shaped section of the whorl, and perhaps also certain forms of sutures occurred in the early stages of some Carboniferous species before the nautilian stage, and consequently they must have been introduced by heredity into the development of this species before the tendency to close coiling had completed the first whorl. Thus these characters, although purely ctetic in origin, were repeated before the usual conditions recurred in the ontogeny of this species which had obviously and repeatedly produced them in the nautilian forms of the earlier paleozoic and the more general-

ized genetic series of the Carboniferous. That this species, *Col. globatum*, is a highly specialized species is shown by other characteristics, especially the early inheritance of a furrowed abdomen, shown at v in Pl. XVIII, fig. 11, and a peculiar aperture.

The Triassic period is unimportant in this connection since it has but few nautilian species that are deeply involute and also sufficiently well known to throw any light upon this problem. All of the true orthoceran, cyrtoceran and gyroceran forms diminish in the Carboniferous and disappear with the Trias.

The Jura contains a considerable number of nautilian shells of different genera of which the cyrtoceran stages are sufficiently well known. *Cenoceros aratum*, of which several specimens have been studied, shows the impressed zone and correlative characters in this stage; *C. lineatum* is the same; *C. clausum*, same; *C. intermedium*, same. Pl. XVIII, fig. 14, shows the cyrtoceran stage in a shell of *C.* , with a well developed impressed zone, i. z. Endolobus is a characteristic paleozoic type and there is a single survivor of this series in the Jura, *End.* (*Naut.*) *excavatum* sp. D'Orb. It is, therefore, very interesting and instructive to note that this species has the impressed zone, according to D'Orbigny's figure, during the cyrtoceran stage. This species has a large umbilical perforation and is slower in coiling up than other Jurassic species. The evidence that the impressed zone and its correlative characteristics are inherited in most species of the Jura before the habit of close coiling could have acted upon the whorls so as to produce this modification is, therefore very general and convincing.

The leading characteristic of parallelism in all genetic series of Nautiloids is, as may be inferred from the facts cited. a tendency toward closer coiling and greater involution in the more specialized forms of each separate series and a correlative increase in the profundity of the impressed zone. When the impressed zone becomes inheritable in some closely coiled and involute specialized shells of the Carboniferous and in similar shells in about all of the genetic series of the Jura

this result is also directly connected with the observed fact of the quicker development of the coiling up tendency in the young of these Jurassic shells. This is shown by the small diameter of the umbilical perforation in the centers of the shells of the Carboniferous. It is also connected with the fact that the primitive uncoiled forms, orthoceran, cyrtoceran and gyroceran shells begin to die out in the Carboniferous and cease with the Trias as mentioned above.

This demonstration of the characters that accompany progress in close coiling, enables me to fill a gap which occurs in the evidence during the Cretaceous. In this period the existence of the impressed zone during the cyrtoceran stage of individuals has not been clearly established by observation except in two species, a form allied to *Cymatoceras pseudoelegans* D'Orbigny, from Faxoe, and *Cymatoceras elegans* from Rouen. In other shells, although a considerable number have been broken down, the state of preservation has been invariably imperfect. The coiling, however, in the young of all the shells examined is notably more accelerated than in the similar shells of the Jura, and the whorls broader and having more specialized characteristics correlative with closer coiling and the early existence of an impressed zone. It is, therefore, fair to infer that the evidence when accessible will confirm the facts observed in previous periods.

The same arguments apply also to the Cenozoics, except that in this period there is as yet no evidence of the early inheritance of the impressed zone. I have not yet succeeded with the Aturia, which is the only genus represented by favorably preserved specimens within my reach, in exposing the apex of the whorl. The shells of this period, so far as I know them, are, however, excessively involute and have exceedingly small umbilical perforations with very deep impressed zones after the whorls touch. The umbilical perforation in Aturia is in fact smaller than in any nautiloid known to me.

The imperfect evidence so far gathered in the Cretaceous, and the absence of positive evidence in the Cenozoics, does not, therefore, seriously affect conclusions reached in this paper, since these are merely gaps in the history of the evolu-

tion or phylogeny of the impressed zone; and all the correlative characteristics which accompany the inheritance of the impressed zone in the cyrtoceran stages of species which have this peculiarity have been observed to be present.

The terminal members of the Nautiloids are, of course, the existing species. *Nautilus pompilius* has been examined in a considerable number of specimens and in all of these the impressed zone and correlative helmet-shaped whorl and broad flattened dorsal side appears during the cyrtoceran stage. Pl. XVIII, figs. 15–16 are outlines of the shell of this species during the cyrtoceran stage exhibiting the helmet shaped whorl, broad dorsum, or inner side, and its impressed zone, iz. Thus, when the whorls touch, as in all the nautilian shells of the Carboniferous, Jura and Cretaceous in which the same acceleration of development also occurs, the whorl is already prepared to become involute and to mould itself more readily and rapidly over the surfaces of the apex and the side of the succeeding whorls. In other words, heredity has begun the work before the whorls touch, and before the deepening and enlargment of the impressed zone through the pressure of close coiling is begun. There are quite a number of characteristics in the species of existing Nautili which lead to the inference that they are survivors of Jurassic and generalized Cretaceous and Cenozoic forms; the size of the umbilical perforations, the smoothness of the shells, the simplicity of the sutures, and so on. These facts are of importance only in so far as they show that the existing Nautilus does not represent the acme of progress of its order but is a descendant of shells with less complicated structures than many of the genera of the Carboniferous, Jura, and Cretaceous.

EXPLANATION OF PLATE XVIII.

LETTERING.

a. Apex of shell. This usually bears a scar on the point, as shown in figs. 14 and 15, but this has no bearing on the question discussed, and has not been described. This also represents the youngest or cyrtoceran stage in the growth of the shell, fig. 8 being a young shell with complete living

chamber. This letter also indicates the location of the sections correspondingly lettered in the figures.

b is used to indicate the section of the cyrtoceran stage in figs. 11–13.

b′ is used to indicate the place of the sections, figs. 4–5b′, upon the whorls of figs. 4–5. They were taken through the whorl in the gyroceran stage.

c is used for the adolescent stage of growth in the whorl and the corresponding sections.

c′ is used for the full grown stage in the growth of the whorl and the corresponding sections:

d for the first part of the senile stage:

e for the final and most degenerative part of the senile stage:

i. z. for the impressed zone.

v venter or outer side of the shell, the dorsum being the inner side of the whorl.

w for the whorls, thus 1 w in figs. 3 and 4 means the end of the first whorl, 2 w the beginning of the second whorl, 3 w that of the third whorl. These letters serve to show the progressive increase in numbers of the whorls in the different classes of forms.

FIGURES.

Fig. 1. Outline of an orthoceran shell.

Fig. 2. Outline of cyrtoceran shell.

Fig. 3. Outline of gyroceran shell.

Fig. 3. Outline of nautilian shell, having a larger umbilical perforation at (a) and fewer whorls at the same age, than in fig. 5, in other words it is less tightly and completely coiled up than the class of shells represented by that figure.

Fig. 5. A nautilian shell with tighter coils than in fig. 4 and the whorls coming in contact and the impressed zone beginning at an earlier stage.

Fig. 6. Barrandioceras——(sp. Barrande) Hyatt, showing the most involute of the Silurian shells so far as known; fig. 6 is reduced in size but the section fig. 7 is natural size.

Fig. 8. A young shell of the same, natural size, with complete living chamber.

Fig. 9–10. Coloceras globatum (sp. De Koninck) Hyatt, adult. Fig. 9 has a part of the outer shell broken off showing the edges of the septal partitions (sutures) as lines on the strong cast of the interior.

Figs. 11–13. Same to show the cyrtoceran stage and section, with its impressed zone.

Fig. 14.

Figs. 15–16. Nautilus pompilius to show the cyrtoceran stage with its impressed zone.

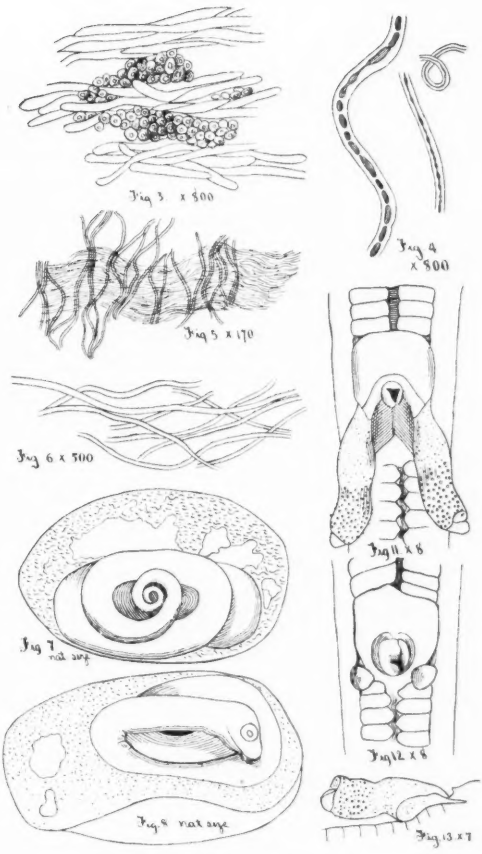
THE EGGS OF PITYOPHIS MELANOLEUCUS.

By J. Percy Moore.

In the absence of any complete published account of the breeding habits of the pine snake, the following notes may interest some of the readers of the Naturalist. The material which furnished the data for this account was collected on Aug. 3, 1892, at Formosa Bog, Cape May Co., N. J., by a party of students from the Sea Isle City Marine Laboratory, who, under the guidance of Dr. J. M. Macfarlane, were engaged in botanical investigation of the region. The nest was brought to their attention through the courtesy of Mr. Peter Hoff, one of those rare genuises of the woods whom it is the pleasure and profit of the naturalist to meet with now and then in his wanderings, and to whom our exploring parties were indebted for many kindnesses.

The snake which mothered the brood was a fine specimen of its kind, nearly six feet in length, and one of Mr. Hoff's most valued companions, for it was well-known to him as a regular habitué of his fields and barrens. At the time of oviposition, which occurred in the middle of May, Mr. Hoff saw the snake traverse the entire length (about 100 yards) of a field planted with squash and cucumber vines, pausing frequently to test the quality of the soil, which was of a loose sandy nature, with its snout. A spot was finally selected by the side of a row of plants, where the more tenacious character of the soil favored the construction of a nest. Excavation was begun by loosening the soil with the head, which was worked under the surface; and the loose earth thrown out. By alternately breaking the ground with the head, and brushing away the loosened soil with the tail, as Mr. Hoff stated, a tunnel was finally constructed of sufficient length to entirely conceal the snake. Within this tunnel it remained entirely hidden from view until oviposition was accomplished, when the entrance was closed and the locality deserted.

PLATE XIX.



Pityophis melanoleucus.

Mr. Philip P. Calvert, who was present at the excavation of the eggs, furnished me with facts relating to their position and surroundings. They occupied an enlargement of the tunnel 6–8 inches below the surface, where they were massed together in a single coherent cluster—the shells being very firmly cemented together wherever they came in contact. Ten eggs in all were found, three of which were detached from the mass in removal; the remaining seven are shown in Fig. 1 (from a sketch by Mr. v. Iterson, the laboratory artist), which I am able to reproduce here through the kindness of Dr. Ryder.

The eggs are of irregular ellipsoidal shapes, varying much in size and proportions, and exhibiting, as a result of the various pressures to which they have been subjected, irregular depressions and protuberances. In size they range from 50x37 mm. to 64x 45 mm., a long narrow egg measuring 61x35 mm., and a short broad one 60x44 mm. The average measurement of the seven is 59x41 mm., exhibiting a mean variation in length of 4 mm., and in breadth of 3 mm. The variation in size is due chiefly, if not solely, to the variable amount of yolk present.

In the hope of raising some of the young, several of the eggs were placed in a box of dampened sand and stood in a sunny spot: but on being opened after three weeks the embryos were dead, and development interrupted at the point that had been reached on Aug. 4, when I received the eggs.

When fresh, the egg-shell was flexible and elastic, and of a very tough parchment-like character; and was very tensely and firmly stretched over its contents; but after a few days' exposure to evaporation, it became somewhat loose and wrinkled.

Its structure is interesting. Externally there is a thin incrustation of calcareous matter, which impregnates only the outer layers of the matted fibres of which the shell is mainly composed, and which appears to be present chiefly in the form of minute crystals and hexagonal plates. Over the greater part of the surface the calcareous crust is minutely cracked into elongated polygonal and irregularly lozenge-shaped areas, resembling the modern "crackle-ware" or the surface of old porcelain (Fig. 2). This appearance is particularly noticeable

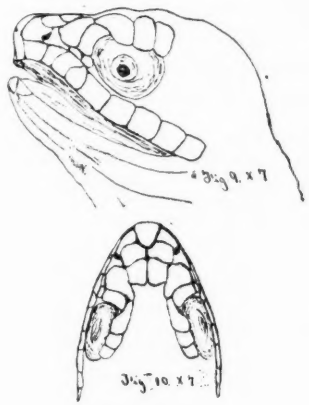
about the equator of the egg, where the long diameters of the areas are parallel to the long diameter of the egg, an arrangement due in part to a conformation of the areas to the curvatures of the surface, and in part to the structure of the fibrous shell. Calcareous deposit is most abundant at the poles of the eggs, and wherever two shells come in contact, they are firmly cemented together by the same material, all of which usually adheres as an elliptical area to one of the shells, when two thus joined are forcibly pulled apart (Fig. 1, a).

The shell is wonderfully tough for its thickness, which is only from $\frac{1}{5} - \frac{1}{6}$ mm., made up, except for the superficial deposit of mineral matter, entirely of highly elastic fibres resembling in their disposition to curl when broken, and their neutral reaction to acetic acid, the yellow elastic connective tissue fibers. These vary somewhat in thickness, the largest having a diameter of $\frac{1}{200}$ mm., the smallest of $\frac{1}{1000}$ mm., and the bulk of $\frac{1}{350}$ mm. They are extremely long, and I rarely found an end not artificially made. Naturally, they seem frequently to terminate in ovoidal or cylindrical swellings which are often sharply twisted, bent or folded. Unlike those which form the shell of bird's eggs, these fibres branched but very rarely, although short filamentous processes were not infrequently seen attached along their sides. Several fibres were traced under the microscope for an inch of their lengths without a single branching being detected. Two or more fibres frequently run side by side for long distances, and separating, give rise to a deceptive appearance of branching.

The most interesting fact to be noted with regard to the structure of the fibres is that they are tubular. Most, if not all of them, possess a distinct and continuous lumen, having a diameter of from $\frac{1}{3}$ to $\frac{1}{2}$ that of the entire fibre. This structure is well-shown in cross section (Fig. 3), and perhaps even more strikingly in specimens which, after having been allowed to dry, are mounted in glycerine, when the lumen becomes very conspicuous from the chain of minute air-bubbles which fill it and mark its course as a dark beaded line (Fig. 4).

The manner in which the egg-shell is built up out of these fibres is strikingly different from what obtains in the mem-

brana putaminis of a bird's egg. Here the shell is built up of a number of distinct laminæ, in each of which the great bulk of the fibres have a generally straight and parallel direction obliquely around the egg, though their course is a regularly wavy one. They do not intricately cross and recross in every direction as in the chick's egg, but the fibres are generally disposed at angles of about 45° to the principal axis of the egg, the direction of the obliquity alternating in successive layers from one side to the other of this axis, so that fibres of successive laminæ are disposed at right angles to one another; those of alternate layers are parallel. The number of laminæ appears to be a matter of some constancy. Specimens from various parts of shells of three eggs were regularly separable into 9 or 10 distinct laminæ, which could be stripped off from the entire extent of pieces an inch square without exhibiting any signs of thinning out. I regard them, therefore, as being continuous over the entire shell. These layers are separable from one another with great ease, but it is noticeable in stripping them apart that a few fibres from one layer are always adherent to the adjacent layers, although there appears to be no extensive invasion of one layer by the fibres of another, except among the external ones. In any one lamina the sinuous course of the fibres causes a firm felting and interlocking among them (Figs. 5 and 6). The alternation of the direction of the fibres is shown in vertical section, but not very clearly, owing to the wavy courses which they take (Fig. 3).



FIGS. 9–10.
Head of Foetal Pityophis.

The optical effects resulting from this structure are striking and peculiar when the entire series of separated layers are

placed side by side in corresponding positions on a moistened slide. Those pieces in which the fibres are disposed at right angles to the rays of light coming in from a window appear, to an eye placed at the proper angle to catch the reflected light, of a beautiful, glistening, satiny white; while those the fibres of which lie parallel to the same rays, and present no reflecting surfaces, appear dull and lustreless. These appearances can be instantly changed from one set to another on revolving the slide over an angular distance of 90.°

A place of natural division, where separation is more readily effected than elsewhere occurs between the 3d and 4th inner layers. The three innermost ones then appear to constitute together the membrana putaminis. There is apparently no disposition toward the formation of a lenticular air-space; this being prevented by the high elasticity of the membranous shell, which causes it to continually contract over the contents as they shrink through evaporation. This contractility appears, however, to be limited, as noted above. Perhaps it is an adaptation to the varying conditions of moisture and drought to which these eggs, and others of their kind, are subjected.

The external six or seven layers are more closely bound together, and constitute the shell proper. The depressions in the surface of one layer resulting from the wavy course of the fibres, accommodate elevations on the surface of adjacent ones, thus greatly increasing the strength of the shell and making possible that partial invasion of one layer by the fibres of adjacent ones which is mentioned above, and which becomes more marked externally. These binding fibres may be seen to stretch and break as two layers are torn asunder.

The wavy structure also produces on the surface beneath the calcareous crust, and especially where two shells have been united, a peculiar pebbled appearance, like the pebbled binding of books. The outer layers in which the calcareous matter is deposited, have a less regular structure—the fibres being more irregularly interwoven; but when the mineral matter is removed with acid, the fibres readily disentangle and separate, being bound by no other cementing substance. Cement sub-

stance appears to be absent also from the other layers; which may be easily teased up, when the fibres float off freely in the mounting medium.

A rough analysis of the shell gives the following results.

Water	29·5 per cent.
Soluble mineral matter (almost entirely calcium carbonate)	16·6 per cent.
Organic matter	53·7 per cent.
	99·8

Well advanced embryos were found within the eggs. These must have been at least 10 or 11 weeks old. Those examined numbered equally males and females. They have an average length of $6\frac{3}{4}$ inches, the tail being $1\frac{1}{16}$ inches in a male and slightly less in a female specimen.

The embryos lie deeply embedded on one side of the abundant yolk, which envelops, and almost completely surrounds them, being packed thoroughly in among the folds; and in alcoholic specimens, requiring to be largely cut away to expose the full length of the embryo. The young snakes are arranged in somewhat irregular spiral coils, the larger folds of which are directed in the long diameter of the egg. There is no regularity in the arrangement of the folds; the spiral being sometimes wound in a left-handed, sometimes in a right-handed direction, figs. 7 and 8. Large clear albuminous masses are frequently embedded in the yolk.

The umbilical cord is short, measuring about $\frac{5}{8}$ inch in length and $\frac{3}{32}$ inch in diameter. It leaves the body anywhere between $\frac{1}{2}$ and 1 inch in front of the vent, between which points the somatic folds are entirely free from one another, while for a distance of an inch to an inch and one-half anterior to the umbilical cord they are only very feebly united. Beyond this point the gastrosteges are complete. These number in all 216 in one ♀ specimen examined—a number slightly less than the adult possesses. The anal plate is single, and the number of scales in a vertical row normal.

On the head the absence of certain plates present in the adult is noticeable. The scutes have not yet developed over

the roof of the prominent brain case, nor in the post-ocular region. The frontal and parietal plates are not indicated at all, and the developed plates show some curious differences from the adult condition. The supraocular is clearly divided by two transverse grooves into three scutes, of which the anterior is largest. I suspect that the others may be really post-oculars which are here displaced by the prominent eyes. A small scute which may unite with the loreal underlies the preocular. Four postfrontals are present, the external pair being much the larger; but the single pair of prefrontals shows no indication of a division. The superior labials number 9, one more than in a specimen of the adult which I have compared. The inferior labials, except the first, are not developed, but the mental is well marked. The description of the head scutes is made from a single specimen, the only one which was well enough preserved to show them satisfactorily; figs. 9 and 10.

The egg tooth is indicated by a narrow fold which arises just below the ventral margin of the rostral scute. Rows of small papillæ on the jaws and palate represent the developing teeth. Their number and position are as in the adult.

In all male examples the paired penes were fully extruded immediately behind the anal plate; rudimentary penes were present in the females as a pair of low conical elevations in corresponding positions, fig. 12. In well preserved specimens each hemipenis is a somewhat compressed organ attached by a narrowed base. A constriction about the middle separates a basal from a somewhat more swollen terminal portion, which ends in a pair of rounded lobes, of which the dorsal is the larger and arises from a thickened rim which is seen to become continuous below with the more ventral lobe. On the external side of each hemipenis is a rather prominent lateral lobe.

Proximad to the median constriction the surface is dotted with numerous fine pointed projections, while the distal portion is covered by larger smoothly rounded papillæ. No papillæ whatever are present on the dorsal terminal lobe, which is quite smooth. Figs. 11–13.

Explanation of Plates XIX, XX.

Pityophis melanoleucus.

Fig. 1—Cluster of seven eggs represented as they naturally cohere. a—point at which an eighth egg was attached. Natural size.

Fig. 2—Surface cracking of the calcareous crust—from an equatorial region. x 10.

Fig. 3—Vertical section of a small portion of the egg shell showing a small part of five laminæ. x 800.

Fig. 4—Several fibres of different sizes after being dried and mounted in glycerin. The lumens are filled with air. x 800.

Fig. 5—Surface view of a small portion of a lamina x 170.

Fig. 6—A few isolated fibres x 500.

Fig. 7–8—Two views of embryos in their natural positions on the yolk. Natural size.

Fig. 9—Left side of head of an embryo showing the scutes. x 7; p. 881.

Fig. 10—Dorsal view of the same x 7; p. 881.

Fig. 11—Anal plate and penes of a male x 8.

Fig. 12—Same region of a female. a—rudimentary penes. x 8.

Fig. 13—Lateral (external) view of a hemipenis x 7.

EDITORIALS.

—Public spirited citizens of Chicago have formed a corporation for the purpose of creating and sustaining a museum, which shall furnish to the public of the city an educational exhibition. It is an opportune time for such a project, as there is much in the Columbian Exhibition that can be obtained, which would serve as a nucleus round which a great museum may be collected. It is proposed that the museum shall be located near to Jackson Park and the University, and for the present the California building, one of the largest of this class in the park, is to be utilized for this purpose. The corporators have made an excellent beginning in appointing Prof. F. W. Putnam the managing director. Thus a scientific stamp is given to the enterprise at the outset, and its future value as an educational medium is secured. It is expected that Professor Putnam will organize the museum into departments, and will place over each a competent head, who will make the institution a medium of original research as well as of exhibition, as is the case with all the great museums of the world. It will thus become useful, not only to the general public, but to the University and to the Academy of Sciences. The corps of scientific experts connected with the museum and the University, would revive the Academy of Sciences, which has been dormant of latter times. This would give it a position in the country second to none west of the Allegheny Mountains, instead of being, as in late years, less productive than the societies of Cincinnati and St. Louis. If Chicago is the city she claims to be, she will do this, and more. She will have an Academy of Sciences which consists exclusively of scientific men. Only such a membership can give an Academy its proper position in the world, and prevent the organization from being a travesty of what it ought to be and might be.

—The Postmaster General of the last administration, Mr. Wanamaker, proposed, it is said, to change the names of the post-offices throughout the country which are duplicates of those previously given to older offices. Perhaps Mr. Wanamaker found the task too onerous; at all events it has never been accomplished. It is hardly likely the present administration will undertake it, as it would savor too much of "paternalism" for democrats to tolerate, but as duplicate names have become an annoying evil, a future administration may make the needed

reform. Nearly all the names of towns with which we are familiar in American geography have now been duplicated, generally several times. New cases appear in the papers continually. We recently noticed a half dozen or more stations on a branch of the Santa Fe R, R. system, whose names have been taken in toto from the time-table of the Pennsylvania R. R., west of Philadelphia. Many or all of these places are or will be post-offices. As the Santa Fe system is controlled in Boston we wonder at this piece of plagiarism (!), for Boston has never been noted for lack of originality. If this is possible from Boston, the stupidity of the rest of the country in the matter of names is easily understood! Nevertheless, Philadelphians (ignoring Kensington and Southwark), may protest in the names of Passyunk, Manayunk and Moyamensing, against such incapacity. There can be only one Chicago, one New York, one Philadelphia, etc., and those communities that duplicate these names simply efface themselves, as the French say. There is nothing easier than to find or invent new names, hence it is incomprehensible why American people should wish to call their homes Paris, Mexico or Berlin. In any case, if geography is to be taught in our public schools, or letters reach their destination, this maze of confusion must be corrected.

—The scheme of Mr. J. C. Bay to publish a yearly bibliography of American botany deserves every encouragement. He proposes an absolutely complete list of all papers upon American botany, accompanied by short abstracts of each, the whole to be published six months after the close of the year. We understand that a publisher has been found who is willing to undertake the publication, but the prompt issue of the volumes will doubtless prove a matter of some difficulty. Thus, of Just's Botanical "Jahresbericht," the volume for 1890 is completed in 1893, the same is true for the Zoological summary of the "Archiv. für Naturgesechihte," while the delay in the appearance of the English "Zoological Record" and the Naples Jahresbericht, though not quite so bad, is very aggravating to those who desire to keep fully abreast with the times.

—The question is often asked, Why do the American zoologists so universally neglect the American Association for the Advancement of Science? For many years scarcely an American publishing zoologist has been present at the meeting while the few papers on zoological subjects are in striking contrast to the interest shown in the sister science of botany. The reasons for this state of affairs are not readily stated.

Possibly most potent of all is the feeling that the association is far from being a representive of American science, and that it has degenerated into an annual junketing party. It is certain that the interests of science have been often sacrificed to excursions which interrupt the sessions, and which should be postponed to their close. Then, too, criticisms are often heard that it is run as a close corporation, that nominating boards are packed in order that certain persons may be put in office and that the expenses of the Association are far greater than they should be for the results achieved. There is, too, an inside history which can not be detailed which would explain a large portion of the indifference displayed. Before the Association can regain its influence it must undergo a complete transformation in its management and methods of administration. It must also present features which will attract the better workers of the country.

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RECENT LITERATURE.

Wiedersheim's Comparative Anatomy.[1]—Professor Robert Wiedersheim has given us two distinct manuals of Comparative Anatomy. One of these, the "Lehrbuch," although it has passed through three German editions, has not appeared in English, while the the other, the "Grundriss" was translated several years ago. This latter, the "Little Wiedersheim," has now appeared in a third edition, and all its claims to being the "little" work have disappeared. It is, in every respect, a new edition, as there is scarcely a page upon which new additions have not been made, while whole sections have been entirely rewritten. It now forms a mine of facts which no morphologist can ignore. Everywhere it seems up to date, the results of investigators in all parts of the world being incorporated into its pages. A work like this cannot be summarized in a few lines, and all we can do is to express our generally high appreciation of the work and to notice a few novelties introduced into the new edition. First of these is an explanation of the names of animals mentioned in the text with a reference to their place in the system, a feature of great value to the beginner. Thus we find "*Cephalaspidae*, armored ganoid from the Devonian and Upper Silurian formations (belongs with the oldest fishes)." Another innovation in this edition is the collection of the literature (as in the "Lehrbuch") in an appendix. In this latter part we could wish that the "running head" of the pages were sub-divided, so as to indicate at a glance the subject below; and, while making criticisms, we would say that were the reference letters in the legends of the cuts arranged in alphabetical order, it would be a great convenience. We learn, incidentally, that a new edition of the "Lehrbuch" is not soon to appear, but the "grundriss" work will be the vade mecum of all students of vertebrate morphology.

Mill's Diatomaceæ.[2]—The scope of this work is best shown by a statement of what it contains. The first chapter treats of what diatoms are and where they occur; the second of their structure; the third of their movements; the fourth of their classification; the fifth of reproduction; the sixth and seventh of collecting and mounting; the eighth of

[1] R. Wiedersheim. Grundriss der vergleichenden Anatomie der Wirbelthiere. III Aufl. Jena, 1893, pp. xxx, 695.

[2] An introduction to the study of the Diatomaceæ, by Frederick Wm. Mills, with a bibliography by Julien Deby. 8 vo. pp. xix, 243, London, Iliffe & Son, Washington, The Microscopical Co., 1893.

the study with the microscope; the ninth of microphotography, and the tenth consists of a large bibliography of diatom literature. Of the general treatment of the subject there is much to be desired. The chapter on microphotography is clear, and will doubtless prove of value to students, but the rest of the work is rather antiquated. Thus, the chapter on the movement of diatoms is based upon an article dated 1866, and is without a single reference to the later literature, the observations of Pfitzer, Schilberszky, etc., being ignored. The bibliography appears to be fairly complete, but the proof-reading of this portion is very bad. The typographical appearance of the book is good, but the publishers have committed the not unusual fault of putting it upon much too heavy paper.

Kennel's Zoology.[3]—In the past three or four years we have noticed not a few German text-books covering a greater or smaller portion of the field of zoology. This is the latest to appear on our table. In most respects it pleases us, in others it does not. Its author is at once too radical and too conservative. Thus he has completely done away with the old group of worms; he denies the validity of the group of Arthropods, and has assigned Amphioxus to the group of Tunicates, the latter group, in his linear arrangement, being sandwiched between the Brachiopods and Molluscs. To descend to details: The work is divided into two parts—general and special zoology. In the first we have, at the beginning, a discourse on what is a species followed by a brief account of evolution, and this in turn by the usual definitions of organic and inorganic, animals and plants, individuals, etc. Then follows the cell, protozoa, tissues and organs. In the special part we find the systematic zoology of the Metazoa with novelties enough. As already hinted, the old group of worms is dismembered, and the Arthropods are given short shrift with a few words like the following: "The Tracheata, which have previously been regarded as a sub-group of the class of Arthropoda, equivalent to the Crustacea, have, as it appears, aside from a series of external resemblances of form and extremities, no nearer relationships to the crabs." The failure to recognize the Chordates as a valid division seems also a questionable procedure. The 310 figures which illustrate the work have been mostly drawn by the author, either from nature or with the use of pre-existing figures, and are largely reproduced by some of the mechanical processes. Many of the diagrams are very instructive. Press-work and paper are good, as we always find them in German text-books.

[3] Lehrbuch der Zoologie von Dr. Julius Kennel. Stuttgart, Ferdinand Enke, 1893, 8vo, pp. xvi x 678.

General Notes.

GEOGRAPHY AND TRAVELS.

The State University of Iowa Biological Expedition to the West Indies and Florida Keys.—A somewhat novel departure along educational lines was successfully carried out during the past spring and summer under the auspices of the State University of Iowa.

A party consisting of three instructors and eighteen students chartered a 116-ton schooner and spent the months of May, June and July in biological work in the vicinity of the Bahamas, Cuba and the Florida Keys. The university furnished a very satisfactory equipment for a biological laboratory which was fitted up on board, a good working library of marine zoology, and also an equipment for dredging down to 250 fathoms, and a collecting outfit for marine work. All other expenses were met by the members of the party, the entire cost, including transportation from Iowa City to Baltimore and return, and board for the entire time, being only $200 for each person.

The first dredging was done on the Great Bahama Banks, where many interesting things were found. Next the party proceeded to the famous "Pentacrinus grounds" off Havana, where they succeeded in securing a quantity of the much-prized Crinoids at depths varying from 150 to 250 fathoms.

When it is remembered that this was done with a *sailing* vessel and *without steam* for hoisting, the members of the party will be pardoned for feeling somewhat elated over their success.

This was the first occasion on which iron rope has been used for dredging at such a depth with a sailing vessel. Many persons considered it impracticable, but Professor Alexander Agassiz thought it could be done. We found that the rope worked admirably and not a single fathom was lost during the three months of the cruise. Of course, no little credit is due the students, who worked manfully at the cranks of the hoisting machine day after day in the tropical heat.

The expedition was accorded many favors by the Cuban Government, and enjoyed the time spent at Havana and Bahia Honda, a port some forty miles to the westward. The local authorities at this latter place, however, seemed to regard the party as a filibustering expedition, in spite of the ladies on board. The shoal water collecting was

PLATE XX.

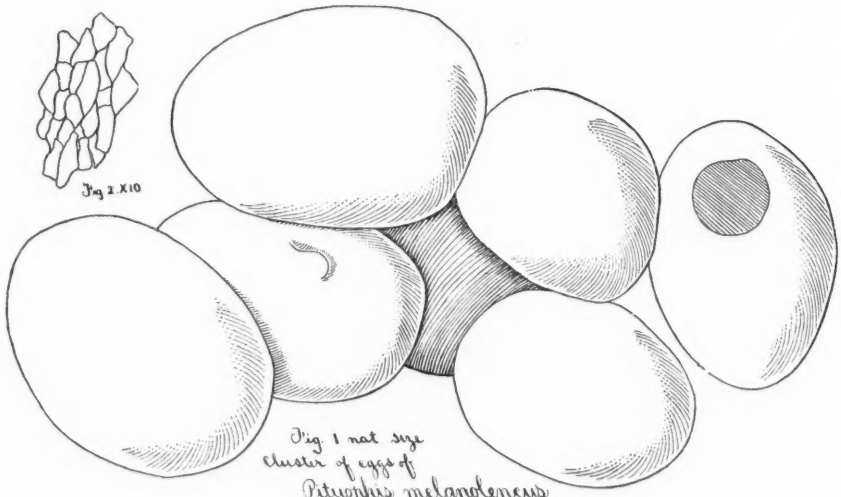

Fig. 1 nat size
cluster of eggs of
Pteroplus melanoleucus

excellent in this region, and a quantity of material was secured, although no one was allowed to go more than thirty yards inland from the water's edge.

From Bahia Honda the Iowans went to Key West, where they were not allowed to land on account of a yellow fever scare, but were ordered to quarantine at the Dry Tortugas, which was anything but a hardship, for a better ground for marine biological work would be hard to find. The quarantine officer, Dr. Robert Murry, was untiring in his courtesies, letting the members of the expedition have the full run of old Fort Jefferson, and, better yet, of the moat around it, which is, in effect, a grand aquarium such as delights the zoological heart.

On two occasions the whole party had the rare privilege of studying fully expanded Millipores, while living corals of many species were always at hand.

Two weeks were spent in dredging on the famous "Pourtales Plateau," between Sand and Sombrero Keys, at depths varying from seventy-five to two hundred and fifty fathoms. A great quantity of material was thus secured, including some characteristic deep-sea forms, such as Asthenosoma, calcareous sponges and old-fashioned corals.

Returning again to the Bahamas, the littoral and terrestrial faunas near Spanish Wells, Eleuthera, were very carefully explored, and a rich harvest secured. The shoal connecting Eleuthera with Little San Salvador was dredged, the most notable results being some particularly beautiful hydroids.

Thence a homeward passage of eight days concluded a cruise which will be remembered with delight by every member of the party, and which was as remarkable for the absence of any mishaps as for the educational and scientific results which will certainly accrue.

In addition to the specimens secured and notes taken by the party, a splendid series of photographs, taken principally by Instructor G. L. Howser, constitute the best of records of the cruise.

—C. C. Nutting.

GEOLOGY AND PALEONTOLOGY.

A New Plistocene Sabre-Tooth.—During the past summer I obtained for the museum of the Academy of Natural Sciences of Philadelphia, some fossil remains of vertebrata from the western part of Oklahoma. These consist chiefly of parts of a single skeleton with teeth of *Elephas primigenius columbii*. Mixed with these were found the bones of a sabre-tooth cat. A few of these only, together with some teeth, were saved. These include parts of three metacarpals, three phalanges of probably a single digit, and the head of the femur. The teeth include five incisors, two superior canines, and two molars, one of them the superior sectorial in perfect preservation. The animal had attained full size, but the epiphysis of the head of the femur is not coossified. The dimensions are equal to those of a lion, (*Uncia leo*), of the same age; and those of the superior sectorial are similar to those of the *Smilodon fatalis* Leidy, and a little smaller than those of the *S. neogæus* Lund, of South America.

Generic character. So far as preserved, the parts agree with those of the genus *Smilodon*, with one exception. This is that the superior sectorial tooth possesses no internal root, not even a rudiment. The protocone is wanting in Smilodon, but its corresponding root is present, but in this form the root also has disappeared, so that it may be regarded as presenting the last stage of specialization in the cats, a circumstance which is appropriate to its late appearance in time. I therefore suppose the species to represent a genus, to which I give the name of Dinobastis.

Specific characters. The canine teeth are large, with elongate compressed crowns, a little more convex on the external than the internal face. The cutting edges are finely serrate. The anterior edge differs from that of the *Smilodon neogæus* in that it turns inward toward the base of the crown, presenting inward. In the *S. neogæus* this edge is not incurved. The superior sectorial has a large anterior basal lobe and a rudiment of a second at its anterior base. It does not attain the importance of a lobe, as it does in the *S. fatalis*. The part of the crown anterior to the paracone forms about one-fourth of the longitudinal extent of the crown; in the *S. fatalis*, is forms about one-third. The paracone is prominent, and is strongly convex on the external face. The metacone has a nearly straight edge, and its external face displays a shallow vertical groove near the middle. The long diameter of its base is 1·5 as great as that of the paracone. The crowns of the

external incisors are oblique, and slightly incurved; they have robust cutting edges, which are finely serrate, and no basal lobes. The incisors 1 and 2 have small conic lobes at the base of the crown, which are well separated from each other at their bases. Those of I. 1 are subequal, while the external of I. 2 is smaller than the internal, and nearer the base of the crown. The crowns proper of 1 and 2 are acutely conic with semicircular section, the posterior face being flat. The edges of I. 2 are feebly crenate; those of I. 1 are smooth.

The metacarpals represented are II, IV and V; of these No. IV is best preserved. It differs from that of the lion in the smaller transverse diameter of the head, and in the fact that the superior face of the diaclast[1] is nearly continuous with the proximal or unciform surface. The shaft is quite as robust as that of the lion. The shaft of the fifth metacarpal is on the contrary more slender. Its section is a triangle with convex limbs, and the obtuse apex external. The phalanges have forms and proportions similar to those of the fifth digit of the lion. The second phalange is a little shorter, and the margins display but small traces of the bases of the sheath, which has been broken off. Otherwise the ungual phalange resembles that of the lion.

Measurements.	mm.
Diameters crown I. 3 { longitudinal,	22
Diameters crown I. 3 { transverse,	13
Diameters crown superior canine { longitudinal,	80
Diameters crown superior canine { anteroposterior,	28
Diameters crown superior canine { transverse at base,	12
Diameters superior carnassial { anteroposterior,	35
Diameters superior carnassial { vertical { paracone,	18
Diameters superior carnassial { vertical { metacone,	13
Transverse diameter of head of femur,	40
Diameters head MC. IV, { anteroposterior, (restored),	22
Diameters head MC. IV, { transverse,	15
Transverse diameter shaft MC. IV at middle,	16
Anteroposterior diameter shaft MC. IV at middle,	11
Length of phalange ? V 1,	38
" " " ? V 2,	24
" " " ? V 3,	22

This species, which I propose to call *Dinobastis serus*, increases the number of our Plistocene Felidæ to four. The three other species are *Smilodon fatalis* Leidy, *S. gracilis* Cope, and *Felis atrox* Leidy.

[1] For the explanation of this term see the Annual Report of the Geological Survey of Texas, 1892, Report on Vertebrate Paleontology of the Llano Estacado, p. 55.

MINERALOGY AND PETROGRAPHY.[1]

Anorthosites and Diabases from the Minnesota Shore of Lake Superior.—Along them iddle stretch of the Minnesota shore of Lake Superior occur several exposures of a light-colored, coarse rock, consisting essentially of a basic plagioclase feldspar which, according to Lawson,[2] is sometimes bytownite; but more frequently anorthite or labradorite. This plagioclase is usually fresh and quite vitreous in appearance. It contains, as inclusions, small bleb-like masses of augite, plates and rods of the same mineral arranged parallel to the clinopinacoid, liquid enclosures, dust particles and small grains of hematite. In addition to the plagioclase there is also often present in the rock a small number of triangular augite plates between the feldspars. This rock which the author calls an "anorthosite," is found in knobs and bosses, and as boulders in the overlying Keweenawan eruptives. The rock is evidently an eruptive which is much older than the volcanic flows constituting a large proportion of the Keweenawan beds.

A second article by the same author[3] treats of the coarse diabase in "gabbro" sheets interpolated between the sedimentary beds of the Animikie. These are thought by the writer to be laccolitic in origin, i. e., to have been intruded between the sedimentaries after these had been solidified, and some of them even later than the time of deposition of the younger Keweenawan series. This conclusion is reached after a careful study of the contacts between the eruptives and the sedimentaries, which has brought to view the existence of contact phenomena at both the upper and lower surfaces of the diabase. The sheets of eruptives have been named the "Logan sills" in honor of Sir Wm. Logan, who was one of the pioneer geologists in the Lake Superior region.

The Volcanic Rocks of the Andes.—In a review of Küch's volcanic rocks of the Andes, Iddings[5] asserts that the chemical relations of the rocks studied indicate clearly that they all belong to the

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2] Geol. and Nat. Hist. Survey of Minn. Bull. No. 8.
[3] Ib. p. 24.
[4] Reiss and Stubel: Reisen in Sud-Amerika. Geologische Studien in der Republik Colombia, I. Petrographie, 1. Die Vulkanischen Gesteine bearbeitet von Richard Kuch, Berlin, 1892.
[5] Jour. of Geology. Vol. 1, p. 164.

same consanguinous group as do the Cordilleran rocks of Mexico and the United States, and their nature indicates that the magma producing the Andes types has not yet become as highly differentiated as that which yielded the corresponding volcanics in North America.

Basalts and Trachytes from Gough's Island.—Pirsson[6] has examined some pebbles gathered from the beach of Gough's Island in the South Atlantic. He finds two of them consisting of basalt, and the others of trachyte glass and tuff. The glass is a pitchy-black mass, filled with small pores and marked here and there by a phenocryst of plagioclase. In thin sections it appears as a brown unaltered isotropic substance containing magnetite, apatite, olivine and saidine phenocysts and microlites of the last-named mineral. An analysis of the rock gave:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	Mgo	CaO	Na_2O	K_2O	H_2O	Total
61.22	.42	18.01	1.32	4.51	tr.	.44	1.88	6.49	5.93	.46	=100.68

Density = 2.210. The rock is thus shown to be unquestionably a trachyte in spite of the fact that it contains occasional olivines. The mineral evidently crystallized in an early stage of the rock's history, as all its grains have been subjected to magmatic resorption.

The Origin of the Gneisses of Heidelberg.—In gneisses occurring in the region northwest of Heidelberg, Osann[7] finds lenticular masses of graphitic and apatite schists, and therefore concludes that the gneisses are of sedimentary origin. The rocks do not possess the true gneissic foliation, since their feldspar, quartz, etc., do not show a sequence in origin, nor do their micas exhibit the pressure phenomena usually observed in the micas of other gneisses. Their structure is described as the "hornfels structure" which is characteristic of contact products. The graphitic schists consist principally of quartz, muscovite, graphite and flecks like the "Knoten" of contact rocks, which are formed by the aggregation of plates of a green micaceous substance. The apatite schist is composed of 55% apatite, 43% quartz, and 2% of graphite, tourmaline and rutile. An analysis gave: CaO = 30.22; P_2O_5 = 22.86; F = 2.16; Insol. = 43.52.

Petrographical News.—Retgers[8] communicates in a few brief notes the results of his examination of rocks collected in southern

[6] Amer. Jour. Sci., XLV, 1893, p. 380.
[7] Mitth. gross. Bad. geol. Landesanst. Bd II, p. 372.
[8] Neues Jahrb. f. Min., etc., 1893, I, p. 39.

Borneo. Actinolite, smaragdite, and glaucophane schists are the most interesting foliated rocks studied. They contain, in addition to their characteristic components: epidote, garnet and orthoclase, most of which show the effects of torsion and pressure. A quartzite is remarkable in that it contains andalusite, sillimanite, rutile, zircon and tourmaline. The eruptives mentioned by the author as existing in this portion of the island are porphyrites, diorite, gabbro, peridotite, serpentine and a pyroxenite (augite-fels).

Analysis of cretaceous lithographic limestones from various localities in America and Germany give such discordant results that Volney[9] thinks it impossible to judge from analyses alone as to the commercial and technical value of such rocks. The organic matter in the stones contains nitrogen and traces of iodine. It is believed to be the residue of cretaceous fossils, and to be the cause of the peculiarly fine precipitation of the calcareous substance of good stones.

The term "poikilite" has already been referred to in this note as descriptive of a rock-structure produced by the inclusion of many differently orientated particles of some mineral irregularly distributed within large plates of another mineral. This structure has been described by so many petrographers as occurring in so many different rocks that Williams[10] suggests its general use and proposes "micropoicelitic" as the term descriptive of the structure when observed microscopically.

Some excellent examples of cone-in-cone structure in a concretion from the coal measures of Wolverhampton, England, are noted by Cole[11] as exhibiting clearly the crystalline structure of these bodies and their identity in mode of origin with spherulitic growths.

The rocks occurring at Cingolina in the Euganean Hills, described by Tchichatcheff[12] a few years ago, have been reinvestigated by Graeff and Brauns,[13] who find augite-syenite and olivine-diabase cut by dykes of hornblende and augite andesites. The plagioclase of the latter rock includes a large mass of the rock's groundmass which has crystallized largely as plagioclase with the same orientation as a thin zone of the same substance surrounding the corroded host.

New Minerals—*Sundtite.*—In some specimens of a silver ore from a mine at Oururo in Bolivia, Brögger[14] finds masses and crystals

[9] Journ. Amer. Chem. Soc., XIV, No. 10.
[10] Jour. of Geol., Vol. 1, p. 176.
[11] Miner. Magazine, X, p. 136.
[12] Neues Jahrb f. Min., etc., 1884, II, p. 140.
[13] Ib., 1893, I, p 123.
[14] Zeits. F. Kryst, XXI, p. 193.

of a dark tetrahedrite-like mineral associated with stibnite and pyrite. The dark mineral is steel-gray, with a black streak. Its hardness is 3–4 and density 5.5. Measurements of the crystals, some of which are 1 cm. long, indicated an orthorhombic symmetry. Twenty-one forms were observed, and from these the axial ratio $a : b : c = .6771 : 1 : .4458$ was determined. An analysis gave :

Cu	Ag	Fe	Sb	S		Total
1.49	11.81	6.58	45.03	35.89	=	100.80

which corresponds to the formula $(Ag_2. Cu_2. Fe)(SbS_3)_2$, or a salt of normal sulph-antimonic acid. Sundtite presents no analogies, either in composition or in its crystallographic characteristics, with other sulph-antimonates. Its nearest crystallographic relative is deschynite (RNb_2O_6). The new mineral is a commercially valuable ore of silver.

Melanostibian is another new mineral obtained by Igelström[15] from the celebrated manganese mine, Sjögrufvan, Grythyttan, Orebro, Sweden. It occurs as narrow veins in the dolomite, which is the bearer of all the ores of the mine. The mineral is in raven black, metallic-looking masses and tiny crystals, that are either tetragonal or orthorhombic. The streak of the mineral is cherry red, and its hardness 4. It is insoluble in dilute hydrochloric acid, but slowly dissolves in boiling acid. Its composition, corresponding to $6(Mn\ Fe)O\ Sb_2O_3$, was deduced from the following figures:

Sb_2O_3	FeO	MnO	CaO	MgO	H_2O	Total
37.50	27.30	29.62	1.97	1.03	1.06 =	98.48

Graphitite.—Upon treatment with nitric acid under certain conditions, the graphite from Ceylon, Norway and Canada yields an oxidation product that is different from the corresponding product obtained from the graphite of Fichtelgebirge, Siberia and Greenland. The materials of the two groups are therefore regarded by Luzi[16] as different, and as worthy of distinctive names. The mineral from the last-named localities is called graphitite.

American Minerals.—The *cookeite* of Paris and Hebron, Me., has been known for some time as a micaceous mineral closely related to the chlorites. In habit its plates are hexagonal, and are nearly always arranged in radial groups. These plates, according to Pen-

[15] Ib. p. 246.
[16] Ber. d. deutsch. chem. Ges., XXVI, p. 890.

field,[17] consist of an inner uniaxial hexagon surrounded by six segments extinguishing parallel to their edges and showing a biaxial interference figure. The mineral is monoclinic and is twinned like the clinochlor[18] from Texas, Pa. It is associated with quartz, lepidolite and tourmaline, and has probably been derived from the latter by alteration. An analysis of carefully selected material gave:

SiO_2	Al_2O_3	Fe_2O_3	CaO	K_2O	Na_2O	Li_2O	H_2O	F	Total	O = F
34.00	45.06	.45	.04	.14	.19	4.02	14.96	.46	=99.32	—.19=99.13

This corresponds to the formula $Li\,[Al(OH)_2]_3\,(SiO_3)_2$. The density of cookeite is 2.675.

The results of an examination of *zunyite* from the Charter Oak mine, at Red Mountain, Orange Co., Colo., and of *xenotime* from Cheyenne Mountain, El Paso Co., in the same State, have recently been communicated by Penfield.[19] The zunyite occurrence is five miles north of the original occurrence of the mineral first described by Hillebrand. The mineral is in little tetrahedrons scattered through an altered porphyrite. An analysis of these gave:

SiO_2	Al_2O_3	Fe_2O_3	Cl	F	H_2O	P_2O_5	CaO	Na_2O	Total	O=Cl&F
24.1	157.20	.61	2.62	5.81	11.12	.64	.11	.48	=102.70	—3.03=99.67

corresponding to $[Al(Cl.F.OH)_2]_6\,Al_2\,(SiO_4)_3$. Zunyite is found also in the mine as a white pulverulent mass resembling kaolin, but which consists of tiny octahedral crystals. The xenotime was from the tysonite locality described by Hidden[20] in 1885. It was a single fresh crystal of a brown color, implanted on a gangue of quartz and feldspar. Its density was found to be 5.106, and its composition: $P_2O_5 = 32.11$; Yt. Er = 67.78; Ign. = .18.

In the crystalline dolomite of Canaan, Ct., Hobbs[21] has discovered a rose-colored *talc*, that is noticeable for its large percentage of calcium and aluminium. Its analysis yielded:

SiO_2	Al_2O_3	MgO	CaO	FeO	MnO	H_2O	Total
61.48	3.04	22.54	4.19	.77	tr.	5.54	= 100.56

The density of the mineral is 2.86. It is optically negative, and its axial angle 2 E is 15° 30′.

In a recent Bulletin of the United States Geological Survey, Mel-

[17] Amer. Jour. Sci., XLV, 1893, p. 393.
[18] Ib. XLIV, p. 201.
[19] Ib. XLV, 1893, p. 396.
[20] Ib. XXIX, p. 249.

ville[22] has given the results of analysis of several American minerals as follows: *Natrolite* (I) from Magnet Cave, Ark.; a light-colored *tourmaline* (II) from Nevada Co., Cal.; *spessartite* (III) from Llano Co., Texas, and *bismuthinite* from Sinola, Mexico. Figures follow:

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	F	B_2O_3
I	47.56	26.82		.20		.13	.09		15.40	9.63		
II	36.40	33.64	3.13			1.51	10.01	.12	2.49	3.53	.74	8.74
III	35.93	18.08		4.60	31.77	8.48	.69	.17		.36	•	

The spessartite contains also traces of TiO_2 and BaO.

Mineralogical News.—W. Ramsay[23] has discovered zonal growths of *epidote* substance in crystals of this mineral from the Sulzbachthal in Salzburg, Zöptan in Moravia, Arendal in Norway, Haddam, Conn., and from Traversella, Brosso and Ala in Piedmont. The different zones possess not only different colors, but they have also different extinction planes and diffent refractive indices, as do also different portions of the same zones.

Fragments and small crystals of carbon with all the physical properties of *carbonado* have been prepared by Moisson[24] upon dissolving carbon in iron and cooling the mass slowly under pressure.

Miscellaneous.—McMahon[25] has elaborated a systematic course in micro-chemical analysis based on the production of the sulphates and double sulphates of the elements. These salts are described as they appear on the object glass under the microscope, their habits are depicted and their constant peculiarities, if they possess any, are portrayed with some minuteness. The methods of analysis developed by the author will prove of great convenience to petrographers if they are found as practicable as they are declared to be.

The eighth volume of the mineral resources of the United States, edited by Dr. D. T. Day,[26] contains statistical data for the calendar year 1891. The total value of metallic products mined during this period amounts to over $181,000,000, and that of the non-metallic products over $241,000,000. The most notable article in the volume is an historical description of the past "twenty years of progress in the manufacture of iron and steel in the United States."

[21] Ib. XLV, 1893. p. 404.
[22] Bull. No. 90. U. S. Geol. Survey, p. 38.
[23] Neues. Jahrb. f. Min., etc., 1893, I, p. 111.
[24] Comptes Rendus, Feb. 6. Ref. in Nature, Feb. 16, 1893, p. 370.
[25] Miner. Magazine, X, p. 79.
[26] Mineral Resources of the U. S. Calendar year, 1891. Washington. Govt. Printing Office, 1893.

ENTOMOLOGY.[1]

Two Twig Galls on Populus Fremontei.—On the 25th of April, 1892, two galls were found on growing twigs of *Populus fremontei* in Las Cruces, New Mexico, and the following are descriptions of them.

Warted Gall.—Length and breadth, 22 mm., thickness 13 mm. Formed on side of twig, round, roughly and irregularly circular in outline, rather flattened, excrescentic or finely warted on the whole upper surface and edges or sides, involving about one-half of the body of the twig, the under surface next the twig covered by the thin spread bark expanded from the involved surface of the twig. Excrescentic portion of gall overlapping the smoother inferior portion on edges, brownish gray in color, the lower surface covered by the spread bark being pale greenish gray like the bark of the twig. Gall woody interiorly, the excrescentic portion filled with small cavities. On twig 5 to 6 mm. in diameter, but spread to 7 mm. at center of gall.

One specimen. Occupants unknown.

Tumor-like Gall.—Length, 12 mm.; width, about 5½ mm.; height (from twig), about 4 mm. Elongate, in shape something like a miniature mud-wasp cell, growing lengthwise on twig like an elongate tumor, one side broadly amalgamated with body of twig. Externally rather smooth, being wholly covered by the distended bark of the twig. Pale greenish gray in color, like the adjoining bark. Gall maker emerges by a circular exit hole 1 mm. in diameter, situated at the tip end of the gall, which is the more pointed end without reference to its being distal or proximal on the twig.

Three galls approximated on same twig, two being grown into each other side by side. A gall fly had escaped from each gall at some time previous to April 3, 1893. Two of the galls showed the exit hole conspicuous and open, but the third appeared to be still tenanted. On examination, however, it was found that the fly had escaped from this one also, but the circular flap of bark, which either the larva cuts on all sides but one before assuming the pupa state or else the adult cuts before it can emerge from the pupal cell, leaving a hinge-like portion intact, had sprung back in place perfectly closing and concealing the place of exit. From the cast pupal skins which remained in the cells, the occupant is apparently hymenopterous.

[1]Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

The larval gallery in one gall was 5 mm. long, by 1 mm. wide. In the other two galls there was nothing but the short terminal cell in which the pupa had lodged until it transformed, being just large enough for its accommodation, the larval gallery having evidently been lost and absorbed during the growth of the twig. In fact, the pressure of the growth was so great that the impression of the pupa was left in the walls of the cell.

—C. H. Tyler Townsend.

A Woolly Leaf-gall on Oak near Grand Canon.—On the approach to the Grand Cañon, by the wagon road to Hance's, July 7, 1892, numerous specimens of a woolly or fuzzy-looking leaf gall were found on a low growth of a *Quercus* much resembling *alba*, at a point several miles from the rim of the cañon. This oak has been identified by Mr. F. V. Coville as *Q. gambelii*.

Gall.—Length, 5 to 9 mm.; greatest width, 3 to 5 mm.; height, 2 to 3 mm. Formed on upper side of leaf, but also showing below, irregularly oblong in outline, nearly always narrower at one end, always on one side of the midrib, extending usually from midrib to margin. Consisting simply of a portion of the leaf puckered up or elevated above the surrounding portion, both surfaces (upper and under) being equally and thickly clothed with very fine woolly but nearly straight hairs, standing straight out from the surface from which they sprung. Pubescence whitish with a greenish, or with a slightly yellowish tinge at least in dried specimens; apparently but an increased abnormal development or hypertrophy and multiplication of the naturally very short pubescence of the oak leaf, very thick and of equal length on upper and lower sides. The pubescence is $\frac{3}{5}$ to $\frac{4}{5}$ mm. long. The puckered portion of the leaf which is elevated and bears this pubescence is not thickened, but of same thickness as rest of the leaf, thus making the thickness of a vertical section of the gall about $1\frac{3}{5}$ mm.

Described from 9 or 10 galls. There is no sign of the gall-maker, and it is hard to see what the larvæ of the latter would feed on unless they are microscopic. It seems certain, however, that this is a gall formed by some insect.

—C. H. Tyler Townsend.

A Hymenopterous Gall on the Creosote Bush.—A peculiar spherical twig gall, much resembling in its formation the fruit of the buttonwood or plane-tree, has been frequently found on the creosote

bushes (*Larrea mexicana*), on the mesa to the east of Las Cruces, New Mexico. All the galls of this species that have been found, however, have invariably been dried and dead ones. No green ones have been met with. The following description is drawn from old galls.

Gall.—Diameter, 18 to 27 mm. Rounded, more or less spherical in general shape, always formed around the twig which usually represents the axis of the gall; consisting of a rather hard central portion formed of resinous closely packed layers of very narrow leaflets radiating in all directions from the central point outward. The larvæ of the gall-maker live and transform in rather closely approximated cells on all sides, in this portion, with their ends all pointed to the center. Outside of this cell-containing portion, the very narrow leaflets, which nearer the center are closely packed into a resinous and nearly solid mass, are prolonged each one separately but more or less disposed in whorls, thickly covering the whole outer surface of the gall. These give the gall a coarsely fibrous appearance, as if it consisted of a knotted bunch of coarse fibers with the ends all sticking outward on the surface. The color of the dried galls is brown, varying from light to dark; that of the growing gall is doubtless green. The cells above mentioned, in which the gall occupants live, are rather elongate, pointed at the inner end, slightly flattened, about $1\frac{1}{5}$ mm. in greatest width one way by $1\frac{1}{2}$ mm. the other, and about 4 mm. long.

Described from three galls collected May 15, 1891. They are with hardly any doubt hymenopterous. Galls contain no remains of occupants. In plan of structure this gall greatly resembles that formed by a species of *Andricus* on leaves of scrub oak in the Organ Mountains. (See Can. Ent., 1892, p. 200).

—C. H. Tyler Townsend.

ARCHEOLOGY AND ETHNOLOGY.[1]

The Exposicion Historico Americano, Madrid, Spain, 1892. (*Continued from p.* 843).—I may be excused if I should give, in a most general manner, some intimation of the displays made by other countries of which we have no catalogue and no report. I should premise this by saying that this Exposition was the finest Pre-Historic or Proto-Historic or Archæologic display of American objects probably ever united under one roof. While we might be able to find more extensive displays from the United States than were here shown, and they might find in Mexico more extensive displays of Mexican antiquities than were at Madrid, and so on with regard to every country of America; but in this Exposition all these good things were brought together, and one had the opportunity, by passing from one hall to another to see the representatives of the good things of all countries. This made it the best thing of its kind ever produced.

Nicaragua adjoins the United States of America. A large proportion of its antiquities came from the Islands of Zapatera and Solentiname, in Lake Nicaragua. A leading object was a sample idol of stone from Zappatera similar to those in my department from the same locality. There were many objects in gold, not the same as those from Chiriqui or Antioquia, but bearing resemblance thereto. There were arrow- and spear-points of obsidian, the polished stone hatchets and similar objects showing them to belong to the Age of Polished Stone. They had quite a number of mealing stones—metates—some with legs and animal feet and animal heads, and altogether curiously-worked objects of art. They had a mass of pre-historic pottery, the shoe-shaped urn, the yellow and red decorated pottery, tripod bowls or dishes. Mr. Myorga, the head of the Commission, classed these as Aztecs, or as having a relation to the Aztec civilization.

Guatemala had an extensive display of antiquities. Stone idols mealing stones—metates—decorated with the heads of animals, stone tables, pestles, hammers, cores, chips, flakes, and arrow-and spear-points of obsidian. They had a fine display of pottery of all kinds and sorts, plain and decorated, of various sizes, and making as complete a series as possible. Their Spanish antiquities, or those brought to them or left there by the Conquistadores, were of considerable number and of

[1] This department is edited by Thomas Wilson, Smithsonian Institution, Washington, D. C.

great interest—swords, halberds, spikes, pieces of armor, clothing, etc., etc. They had not a few literary works of literary and historic value, ancient books in manuscript, olographs and autographs of their great men.

The History of the Province of San Vicente Ferrer, a work by the Friar Francisco Ximenez, which, at whatever time it was commenced, seems to have been finished before 1720; another, "Isagoge Apologetico, General de las Indias." Photographic reproductions of the original volume of the history, by Bernard Diaz.

The Dominican Republic.—This little country was represented in greater part by historic than by prehistoric objects. Its cargo was composed principally of those objects which related to the Spanish occupation. One of principal interest was the First Cross. It was made of wood, erected in the first church that was established in the western world. Some of the stones of that construction, the plate, and similar objects, had greater value to the eyes of the Dominicans than others of greater scientific value.

In the display of Peru, the Argentine Republic and Uraguay, they exhibited more of the Inca civilization than of the Aztecs. The display was not formidable in numbers, nor were the objects of great size, but there was enough to assign them to the same scale of civilization as that which belonged to the Age of Polished Stone. There were objects of copper and gold.

Ecuador had an abundant collection of pottery of different forms, as of vases, dishes, platters, cups, figures of animals, and human representation, etc., of the usual form—the antique stone-work of the same description, polished stone hatchets, stone mortars, mealing stones, pestles, and copper implements, etc.

One of the peculiar objects presented in the Exposition at Madrid (and there were only three of them in the entire Exposition) was a Mummified human Head, the bones having all been removed, and it being reduced in size to about that of one sixth, skin and features all retained in proper proportion, the hair long and black, with a half-dozen strands of cord drawn through the lips.

Costa Rica was represented by her Minister, Senor Peralta, by Mr. Alfaro, Director of the National Museum at San José, and by Mr. Ferraz. Costa Rica had two large rooms assigned to her, and though one of the smallest countries, she filled and adorned with beauty and taste, the large space assigned to her. She displayed a considerable number of large stone objects, exceeding, in this regard, almost any other of her sister countries—stone objects in human form, others in animal form

and apparently of natural size. The display of pottery was large and that shown was of a superior order. This collection was very extensive, and included every kind, both in shape and size, of pottery which belonged to the country. But that which was particularly interesting about Costa Rica was her unusually large display of gold objects. The greater part of these had never been shown in any public exhibition; they had been, for the most part, excavated and exhumed by Mr. Alfarro himself, or through his immediate exertions. I had no opportunity to examine them save in a slight and cursory manner; it would seem to be established that they were made, in addition to other supposed methods, by melting and casting. I had the privilege of taking some of them apart myself and choosing those pieces which had the greatest appearance of solder. I found no trace thereof, but it appeared impossible to have been done otherwise than by casting. I would not be understood to intimate that all of them were made thus, nor that none were made by soldering.

Sweden and Norway.—These two countries which occupy so close a relationship politically, were very properly installed together. Baron Nordenskiold was the Chief Commissioner, with Professor Bovallius for his aid. The center of the hall was occupied by a large glass case, the dimensions of which were to be counted by yards. It contained a model of the ship Vega, in which the Chief Commissioner made his celebrated discoveries and voyages in 1878–80. Arranged in the same case and making part of the display, were the various implements, tools, weapons, arms, domestic utensils, ornaments, dress, etc., of the people visited during the voyage. Associated with them were the Kyaks of Alaska, all the dress of the fishermen and hunters while on the water, and their arms, instruments and weapons.

One of the most interesting displays of the entire Exhibition was the ancient maps, the nucleus of which was the private collection of Baron Nordenskiold, and which he had been forming during many years past—atlases, maps, charts, globes, etc., were here without number—some of them the rarest and most valuable to be found. One corner of the hall was devoted to the discoveries and investigations of Mr. Gustavus Nordenskiold, the son of the Baron, among the Pueblos and Cliff-dwellings of Arizona and the Cañons of the San Juan and its tributaries. The volume containing a description of his discoveries, with all the necessary illustrations, is now in course of publication in Sweden, to be made in English as well as Swedish, and intended to be a rich and valuable volume.

Collections of Archæologic specimens by Dr. Bovallius during his visit of exploration in Nicaragua, were here displayed, as well as the same in the Antilles by Dr. Hjalmarson. Norway presented but a small display, the principal and most attractive item of which was a model of the great Viking ship which had been excavated from the tumulus of Godhav'n, now on display in the Archæologic Museum at Christiania, a smaller model of which is in the National Museum.

Denmark had a modest display, considering her Archæologic riches, but she was bound by the condition governing this, that, though but a novel and interesting departure, her display was confined almost exclusively to the discoveries made by the Danes through Iceland upon the Atlantic Coast, and so here was to be found a good representation of Greenland and Eskimo life from that country. Accompanying this Greenland display, were maps, charts, publications of every sort relating to the early discovery of America by the Norsemen. The maps, real or imaginary, of Massachusetts Bay and the coast of New Jersey, with the supposed voyages of the discoverers of the X and XI Century, at least in completeness. Whatever of relics that could be gathered were here displayed, and, altogether, it was the most satisfactory argument in favor of the discovery of America anterior to Columbus that has ever been made.

Germany.—The German representative was Dr. Ed. Seler, and he presented, in the hall allotted to him, the riches of the German Museum as they have been gathered during the many enterprising voyages of scientific investigation which his country has started throughout the Western Continent. Dr. Seler's investigations and discoveries in Guatemala, Honduras and the Mosquito Coast were here exhibited the form of a plaster or pulp reproduction of a score or more great Aboriginal monuments of those countries, so strange and wonderful, so little known. The investigations of Reiss and Stübel in Peru and representatives of the great collection made by them—first, of painted and decorated pottery, and second, of the polochromatic textile fabrics, was much to be admired.

United States of Colombia.—This country had but a small display. It was visited by me two or three times, each time with increased interest. Although I saw other objects during my first visit, my attention was soon attracted to the display of gold objects which this country possesses from the interior Province of Antioquia.

The National Museum possesses 20 or 30 of these gold specimens of this country, and feels that it already possesses a sufficient number and must decline to increase that number by purchase. Imagine my sur-

prise to see in the display of this little country, sloping shelves, three or four feet wide, covered with black velvet, running along an entire side of the room, however, within glass cases which were abundantly guarded, and dotted over this black velvet were gold objects to be counted by the hundred—how many there were, I do not know. There were parts of two collections, one of which cost in Colombia, $75,000, and the other, that of Don Restrepo, who was present representing his country at Madrid, which cost $30,000. I, as Curator of my Department, had selected my little display of gold ornaments and taken them to Madrid, intending them for exhibition, but when I saw this magnificent and glittering display of prehistoric gold ornaments from this little country, I decided I could never put mine on display, and, upon preparing for my return, carefully packed them up and brought them home with me, and they are now displayed in their usual place in my department of the Museum.

Mexico.—She is our neighbor at home and she was our neighbor at the Exposition. She occupied about the same number of rooms as we did. While she had more objects, they were smaller and did not take so much space. I give the nearest sketch of some of the objects presented by Mexico, principally from memory: Models and reproductions in plaster, paper or staff of several of the principal monuments of their country. All that we have in our Museum of the Abadiano and Lorillard Collections were thus represented, if I may except the Calendar Stone, which unfortunately met with an accident well provided against, but which wrought its destruction. The monument was natural size, the same as we have in our museum, and was made of paper pulp; to guarantee safe carriage it had been hermetically sealed and soldered in a case of sheet lead, and this, with the necessary protecting straw, etc., was, in its turn, placed in a wooden box. It was brought by ship and landed at Santander. The attempt to bring it down through Spain by car, proved it to be too large to pass through tunnels and similar narrow places, and it therefore had to be brought by wagon. At some part of the voyage it was necessary to move or change the object, and for that purpose wooden strips had been nailed along the sides of the case to be used as handles. When placed on the wagon for transportation, these strips were pulled off and the nails by which they had been fastened, pulled out, leaving nail-holes upward and exposed to the weather. It rained upon the load nearly every day of the transport across the mountains, and enough water trickled through these nail-holes to dampen, then wet, and finally destroy the paper pulp of which the model was made, and when it was

opened in the palace, it had been resolved into its original pulpy condition. The Stone of Sacrifice, the God of Silence, Teoyoamiqui and all the rest came through in safety. The Mexican section displayed models in wood, of several of their antique monuments, and sometimes the country around them on a reduced scale. The Aztec town of Zempoala, the Pyramid of Papaulta, and the Ruins of Xochicalco, were fine models. They occupied places in the center of each room. There were the usual amount of antique armor, arms and instruments, stones, ornamental utensils, and worked bone. There were a hundred or more of the T-shaped copper implements, quantities of pottery, etc. There was a fine series of plaster reproductions of the ancient inhabitants, showing individuals of both sexes and all ages, and attempting to reproduce the races or tribes from the different provinces. This reconstruction extended to their clothing and equipments, their arms, offensive and defensive, tombs, utensils, household and ceremonial, and the original adornments of gold and other reproductions. There was a fine series of maps, charts, and the originals of two Codicxes with paintings and sketches.

This display was intended at the time of its preparation in Mexico to be transported to Chicago for the World's Columbian Exposition, but the postponement of closing time at Madrid, and the necessity for its shipment *via* Havana prevented. Could this display have reached Chicago, Mexico would have appeared to much better advantage in this department.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Proceedings of the Botanical Club, of the Forty-second Meeting of the A. A. A. S., Madison, Wisconsin, August 16–22, 1893.—(Condensed from the Secretary's notes.)—Friday, Aug. 18.—The president and secretary being absent, the club was called to order by the vice-president, Professor W. A. Kellerman, and on motion W. T. Swingle was elected Secretary.

The committee on Nomenclature, continued from the last meeting, made the following report:

"To the Botanical Club of the A. A. A. S.: Your committee appointed at the Rochester meeting to prepare a check list of the flowering and fern plants of northeastern North America on the rules of nomenclature adopted by the club at that meeting would respectfully report:

"That the task assigned the committee has been performed, and the manuscript of the list is herewith presented, nearly complete for printing.

"The committee presents the following recommendations:

"1. The amendment of section III of the Rochester code of nomenclature by striking out all after the word 'retained.'

"This recommendation is based on the mature judgment of the committee after watching for a year the progress of the demand for a rule which shall permit no exception whatever, and effect the closest approximation to the immutability of the specific name.

"2. The publication of the check list for the club by the committee and the continuance of the committee for that purpose.

"3. That the form and the time of publication be referred to the committee with power to act.

"4. That the general sequence of the natural orders as taken up in Engler and Prantl's "Natürlichen Pflanzenfamilien" be adopted.

"5. That in determining the name of a genus or species to which two or more names have been given by an author in the same volume or on the same page of a volume, priority of place shall decide.

"6. That in the elevation of a plant originally described as a variety to a species, or the reduction of a described species to a variety, the original name shall in all cases be retained."

On motion the recommendations were taken up in order for discussion and action. The first recommendation was adopted after some

discussion. On motion the consideration of the second recommendation was postponed until after the others were disposed of.

On motion the third recommendation was also postponed.

On motion the fourth recommendation was adopted unanimously.

On motion the fifth recommendation was amended to read "That in determining the name of a genus or species to which two or more names have been given by an author in the same volume or on the same page of a volume, precedence shall decide. On motion it was adopted as amended.

The sixth recommendation was discussed some time but was not brought to a vote before the club adjourned until Monday.

Monday, Aug. 21.—On motion the chair was authorized to appoint a committee of two to nominate officers for the next meeting. Prof. A. S. Hitchcock and Dr. Erwin F. Smith were placed on this committee.

On motion the remaining portions of the report of the committee on nomenclature were referred back to the committee with instructions to report Tuesday morning.

The report of the treasurer was then read, showing a deficit of $6.16. This deficit was liquidated by voluntary contributions.

The following papers were read:

Mrs. E. G. Britton, "The genus Bruchia in North America, with description of one new species." Mrs. E. G. Britton, "The necessity of seeing types." Prof. A. S. Hitchcock, "*Ampelopsis quinquefolia* var. *vitacea* Knerr." Dr. J. C. Arthur, "Exhibition of a centrifugal machine." The instrument is a new one devised by the author, costing much less than those made in Germany. Mr. T. C. McDougal, "Intertwining of tendrils." Mrs. E. G. Britton, "Jaeger's Adumbratio, and herbarium of mosses." The whole moss herbarium of Jaeger on which the Adumbratio was founded has come into the possession of Columbia College. Dr. W. A. Kellerman, "Notes on the exploration of the flora of Ohio." Prof. A. S. Hitchcock, "Pollination of *Œnothera missuriensis* and *Pentstemon cobœa*."

Dr. D. H. Campbell, "Prothallial stage of Ophioglossaceæ." Records finding during the present year what are with little question the prothallia of *Botrychium*. Dr. Erwin F. Smith, "The increasing prevalence of a root disease of stone fruits." Dr. C. E. Bessey, "The use of personal names in designating species." Objects to the abuse of this practice by botanists.

Tuesday, Aug. 22.—The following were elected officers for the next meeting:

President, Dr. D. H. Campbell, Leland Stanford Jr. University, Palo Alto, California; vice-president, Professor D. C. Eaton, Yale College, New Haven, Conn.; secretary-treasurer, W. T. Swingle, U. S. Sub-tropical Laboratory, Eustis, Florida.

The committee on nomenclature then reported that they had reconsidered all the remaining portions of the report which had been referred back to them, and were unable to bring in any other recommendations. On motion these remaining portions of the report were referred to the committe with power to act, and the committee was continued.

The committee appointed at the Rochester meeting to consider the feasibility of establishing an American Botanical Society presented a majority report adverse to forming such an organization at the present time and place. Prof. C. R. Barnes then presented a minority report favoring the project, and outlined a plan of organization, providing for a committee of twenty-five to constitute the charter members.

On motion the minority report was adopted by a vote of 21 to 10.

The committee of twenty-five is as follows: J. C. Arthur, Lafayette. Ind.; G. F. Atkinson, Ithaca, N. Y.; L. H. Bailey, Ithaca, N. Y.; C. R. Barnes, Madison, Wis.; C. E. Bessey, Lincoln, Nebr.; Mrs. E. C. Britton, New York, N. Y.; N. L. Britton, New York, N. Y.; D. H. Campbell, Palo Alto, Cal.; J. M. Coulter, Lake Forest, Ill.; F. V. Coville, Washington, D. C.; D. C. Eaton, New Haven, Conn.; W. G. Farlow, Cambridge, Mass.; E. L. Greene, Berkeley, Cal.; B. D. Halsted, New Brunswick, N. J.; Arthur Hollick, New York, N. Y.; Conway Macmillan, Minneapolis, Minn.; B. L. Robinson, Cambridge, Mass.; C. S. Sargent, Brookline, Mass.; F. L. Scribner, Knoxville, Tenn.; J. D. Smith, New York, N. Y.; Roland Thaxter, Cambridge, Mass.; Wm. Trelease, St. Louis, Mo.; L. M. Underwood, Greencastle, Ind.; L. F. Ward, Washington, D. C.; W. P. Wilson, Philadelphia, Pa. The reading of papers was then resumed as follows:

Dr. J. C. Arthur, "A self-registering auxanometer." A relatively inexpensive instrument devised by the author. Dr. B. D. Halsted, "A new Exobasidium on Andromeda." Dr. B. D. Halsted, "Phyllosticta following insect work." Dr. B. D. Halsted, "A white-smut new to America." Dr. B. D. Halsted, "A water-loving Ascomycete." Mr. W. T. Swingle, "A new palm from Florida." Mr. W. T. Swingle, "The southernmost botanical laboratory in the United States." Giving a short account of the Sub-tropical Laboratory of the Division of Vegetable Pathology, lately established at Eustis, Florida, by the U. S. Department of Agriculture. A. B. Seymour, "Synonymy of *Valsa*

stellulata and its allies." A. B. Seymour, "A key to species of Cladonia." Mr. Seymour exhibited this key, the work of F. L. Sargent. S. A. Beach, "Some observations on black-knot."

For want of time the following papers were read by title: L. H. Bailey, "Sand-Dune weeds." W. W. Rowlee, "The propagation of *Ranunculus delphinifolius* by runners." E. J. Durand, "Some notes on the germination of the spores of *Enteridium rozeanum*." C. V. Riley, "Herbarium entomology." C. V. Riley, "Yucca pollination." B. T. Galloway, "Notes on 'hexenbesen' of Rubus." B. T. Galloway, "Some methods employed in the investigation of parasitic fungi and other organisms."

Upon motion two members were added to the committee on nomenclature. Dr. Wm. Trelease, and Dr. E. L. Greene were named.

The club then adjourned until the next meeting of the A. A. A. S. —CHARLES E. BESSEY.

SCIENTIFIC NEWS.

Among the recent deaths we notice those of Leonard Blomefield, the veteran naturalist of Bath, England; George William Shrubsole of Chester, England, aged 66; Miss Anne Pratt, the author of "Flowering Plants and Ferns of Great Britain," aged 87; the geologists, D. Homfray and George Robert Vine; and Franz Kiaer, the bryologist of Christiania, Norway.

Many Americans will learn with regret of the recent death of Mr. George Brook. He was born at Huddersfield, England, in 1857, was trained in business in his father's cotton mills, but soon turned to science. His early work was done in an admirably equipped private laboratory at home where he maintained marine aquaria and studied the embryology of the Teleosts. In 1884 he became connected with the Scotch fishing board and in 1885 was appointed lecturer on embryology to the University of Edinburgh. Among his more important papers may be mentioned his "Challenger" memoir on the Antipatharia and his catalogue of the Madreporarian corals of the British Museum, one volume of which was issued just before his death, which occurred August 12, as the result of sunstroke.

Mr. James William Davis of Halifax, England, died July 21, 1893, at the age of 47. He is best known for his monographs on the fossil fishes, the results of studies carried on in moments snatched from the large business enterprises carried on by himself and his brother.

D. T. Macdougal, formerly assistant in the biological laboratories at Purdue University at Lafayette, Indiana, has been appointed instructor in plant physiology in the University of Minnesota.

Dartmouth College is to be congratulated in its call of Dr. William Patton to the newly established Chair of Biology.

Professor Dr. J. Sollas has been appointed petrologist to the geological survey of Ireland.

Dr. A. Dendy, well known for his researches on sponges, has been appointed Professor of Biology in Canterbury College, Christchurch, N. Z., and will enter upon his duties there, February 1, 1894.

Mr. E. Uline has been appointed Curator of the Herbarium in Lake Forest College, Lake Forest, Ill.

Maximilian von Hantken, the Hungarian geologist died last June. He was professor of Palæontology in the University of Buda Pesth and councilor of the Hungarian Ministry.